

Coral Conservation Plan

Maritimes Region (2006-2010)

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**Oceans and Coastal Management Report
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Executive Summary

A Coral Conservation Plan for the Maritimes Region was developed to meet several needs: to document what has been done to conserve corals, put forward a more comprehensive approach on coral conservation, to identify issues where more work is needed, and to build collaboration among a variety of groups to address coral conservation. The plan was developed as part of the Eastern Scotian Shelf Integrated Management Initiative (ESSIM), a collaborative planning initiative in the region.

The Coral Conservation Plan is related to two pillars of Canada's "Oceans Action Plan:" Integrated Oceans Management for Sustainable Development and Health of the Oceans. The Oceans Action Plan has identified the Scotian Shelf as a priority area for integrated management planning in Phase 1 of the OAP. The development of a Coral Conservation Plan that includes the Scotian Shelf in its scope is a reflection of its priority in integrated management and planning. Phase 1 of the Oceans Action Plan has resulted in funding for some coral management, conservation and research activities. In terms of any funding allocated to coral conservation, management and research, priority actions will follow the priorities outlined in the Coral Conservation Plan.

Objectives for the Coral Conservation Plan are as follows:

Conservation Objectives

- Conserve the health and integrity of coral communities
 - Minimize the impacts from human activities on coral communities
 - Protect and, where necessary, restore important coral habitats

Management Objectives

- Integrate coral conservation requirements into existing management processes.
 - Where necessary, build capacity to address management requirements.
- Implement a flexible and adaptive approach to management and decision-making.
 - Base decision-making on coral conservation on the best available information.
- Consider and evaluate resource use activities when carrying out coral conservation planning and management.
- Provide information to the public on corals and coral conservation measures.
- Collaborate with the international community on cold water coral issues.

Research Objectives

- Support and promote scientific research on corals, including research on:
 - Understanding and assessing the impacts of human activities on corals
 - Distribution of corals
 - Evaluating current and proposed management measures to conserve corals

- Continue to identify research priorities for corals.
- Foster information-sharing and collaboration on coral research.
- Support socioeconomic research related to coral conservation.

About 25 to 30 species of corals occur off the Atlantic coasts of Nova Scotia and New Brunswick. There are about 8 species of stony corals (Scleractinia), including the reef-building coral *Lophelia pertusa* (spider hazards). About 19 species of soft corals, leather corals and sea fans (octocorals) are known to occur, including the large gorgonian corals *Paragorgia arborea* (bubblegum coral) and *Primnoa resedaeformis* (sea corn).

Strategies and actions that aim to meet the objectives are outlined for the plan. The strategies and actions are for the lifetime of the plan (2005-2010) and the following high priority activities were identified:

High priority actions for conservation and management

- Ensure Coral Conservation Areas and the Gully MPA are incorporated into ocean use planning and management processes, such as fisheries management plans and environmental assessments.
- Continue activity monitoring of the Coral Conservation Areas and the Gully Marine Protected Area, including surveillance and enforcement of management measures and working with affected users to address compliance issues associated with area restrictions
- Apply appropriate management measures to protect important coral habitats, if the site evaluation process determines this is necessary.
- Provide opportunities for input to decision-making on coral conservation
- Disseminate information on corals and coral conservation, particularly to affected activity sectors

High priority actions for research

- Secure funding for benthic habitat and cold-water coral research, including building core capacity within DFO Science and pursuing funding opportunities with external funding bodies.
- Conduct research to evaluate the effectiveness of conservation measures, such as Coral Conservation Areas.
- Conduct research on impacts of human activities on corals and sensitivity of different coral taxa, including types of damage and recovery rates, which will require research on coral reproduction and recruitment
- Identify important coral areas in the region, which will require building capacity to conduct deep-water research and surveys on benthic habitats (i.e., below 500 metres).

- Assess socioeconomic costs and benefits of coral conservation for human activities.

In addition to identifying strategies and actions, the plan also puts forth a site evaluation process for considering appropriate management measures for areas with corals.

The Coral Conservation Plan will be considered by the ESSIM stakeholder advisory body and the evolving ESSIM governance processes. Until the ESSIM governance structures are set up, approval for the plan has been sought from the relevant regulators (e.g., DFO, CNSOPB) at the Regional Director-General level.

The ESSIM Planning Office (Oceans and Habitat Branch, Maritimes Region, Fisheries and Oceans Canada) will provide coordination for the implementation of the plan and track the progress of the strategies and actions proposed in the plan. The Planning Office will work closely with other parts of DFO, other government regulators, and industry, research, and non-governmental organizations to implement the plan.

As the plan is implemented, regular reports on activities related to the plan will be provided in updates to the ESSIM Forum. The Coral Conservation Plan will be reviewed and revised every five years (i.e., by 2010) or sooner if required under the ESSIM Plan.

Sommaire

Un Plan de conservation du corail applicable à la Région des Maritimes a été élaboré pour répondre à divers besoins : documenter ce qui a été fait jusqu'ici pour conserver les coraux, proposer une approche plus exhaustive en la matière, cerner les aspects de la question qui nécessitent davantage de travail et établir une collaboration à la conservation du corail entre divers groupes. L'élaboration du plan s'inscrit dans l'initiative de Gestion intégrée de l'est du plateau néo-écossais (GIEPNE), une initiative de planification concertée dans la région.

Le Plan de conservation du corail repose sur deux éléments fondamentaux du *Plan d'action pour les océans* du Canada, soit la gestion intégrée des océans pour un développement durable et la santé des océans. Dans sa phase 1, le Plan d'action pour les océans fait du plateau néo-écossais une zone prioritaire pour la mise en œuvre d'un plan de gestion intégrée. L'élaboration d'un Plan de conservation du corail qui englobe le plateau néo-écossais reflète la priorité accordée à ce dernier dans la planification et la gestion intégrées. Dans le cadre de la phase 1 du Plan d'action pour les océans, on a pu financer certaines activités de gestion, de conservation et d'étude du corail. Pour ce qui est d'affecter des fonds à toute activité de conservation, de gestion et de recherche concernant le corail, les priorités suivies seront celles qui sont établies dans le Plan de conservation du corail.

Voici quels sont les objectifs du Plan de conservation du corail :

Objectifs de conservation

- Conserver la santé et l'intégrité des communautés de coraux
 - Réduire l'incidence des activités humaines sur les communautés de coraux
 - Protéger et, si nécessaire, rétablir les habitats importants pour les coraux

Objectifs de gestion

- Intégrer aux processus de gestion existants les besoins en matière de conservation du corail.
 - Si nécessaire, développer les capacités voulues pour répondre aux besoins de gestion.
- Mettre en œuvre une stratégie de gestion et de prise de décisions qui soit souple et adaptative.
 - Fonder le processus décisionnel en matière de conservation du corail sur la meilleure information disponible.
- Prendre en considération et évaluer les activités d'utilisation des ressources dans la planification et la gestion de la conservation du corail.
- Renseigner le public sur les coraux et sur les mesures prises pour les conserver.
- Collaborer avec la communauté internationale aux questions concernant les coraux d'eau froide.

Objectifs de recherche

- Soutenir et promouvoir la recherche scientifique sur les coraux, notamment dans les domaines suivants :
 - La compréhension et l'évaluation des incidences des activités humaines sur les coraux
 - La distribution des coraux
 - L'évaluation des mesures de gestion actuelles et de celles qui sont proposées pour conserver les coraux.
- Continuer d'établir des priorités en matière de recherche sur les coraux.
- Encourager le partage d'information et la recherche concertée sur les coraux.
- Appuyer les études socio-économiques connexes à la conservation des coraux.

On dénombre de 25 à 30 espèces de coraux au large de la côte atlantique de la Nouvelle-Écosse et du Nouveau-Brunswick. Elles comprennent environ 8 espèces de madréporaires (Scléactinies), notamment le corail *Lophelia pertusa* qui construit des récifs et environ 19 espèces de coraux mous, coraux cornés et éventails de mer, y compris les grandes gorgones *Paragorgia arborea* et *Primnoa resedaeformis*.

Les stratégies et mesures suivies pour atteindre ces objectifs sont décrites dans le plan et s'appliquent sur toute la durée de celui-ci (2005-2010). Voici les activités qui ont été placées au premier rang des priorités :

Activités de conservation et de gestion hautement prioritaires

- Veiller à intégrer les zones de conservation du corail et la ZPM du Gully aux processus de planification et de gestion des utilisations de l'océan, par exemple aux plans de pêche et aux évaluations environnementales.
- Continuer la surveillance des activités dans les zones de conservation du corail et la zone de protection marine du Gully, notamment la surveillance de la conformité aux mesures de gestion et travailler de concert avec les utilisateurs visés pour traiter des questions de conformité connexes aux restrictions applicables à ces zones.
- Prendre les mesures de gestion voulues pour protéger les habitats importants pour le corail, si le processus d'évaluation des lieux révèle que cela est nécessaire.
- Donner aux intéressés la possibilité de prendre part au processus décisionnel concernant la conservation du corail.
- Diffuser des renseignements sur les coraux et sur leur conservation, en particulier dans les secteurs d'activité touchés.

Activités de recherche hautement prioritaires

- Se procurer les fonds nécessaires à la recherche sur l'habitat benthique et les coraux d'eau froide, notamment sur le développement de la capacité de base

au sein des Sciences du MPO, et rechercher des possibilités de financement auprès de bailleurs de fonds de l'extérieur.

- Effectuer des recherches en vue d'évaluer l'efficacité des mesures de conservation, comme les zones de conservation du corail.
- Effectuer des recherches concernant les incidences des activités humaines sur les coraux et la vulnérabilité des différents taxons de corail, notamment sur les types de dommages qu'ils subissent et sur leur taux de rétablissement, ce qui nécessitera des études de la reproduction et du recrutement du corail.
- Cerner les zones coralliennes importantes de la région, ce qui nécessitera le développement de capacités pour effectuer des recherches en eau profonde et des relevés de l'habitat benthique (c.-à-d. à plus de 500 mètres de profondeur).
- Évaluer les coûts et avantages socio-économiques de la conservation du corail sur les activités humaines.

En plus de définir des stratégies et des mesures, le plan offre aussi un processus d'évaluation des lieux qui permet d'envisager des mesures de gestion pertinentes dans les zones coralliennes.

Le Plan de conservation du corail sera examiné par l'organe consultatif des intervenants de la GIEPNE et les structures de gérance du GIEPNE, qui sont encore en évolution. En attendant que ces structures soient mises en place, on a sollicité, à l'échelle du directeur général régional, l'approbation de ce plan par les instances de réglementation compétentes (p. ex. le MPO, l'OCNEHE).

Le Bureau de planification de la GIEPNE (Direction des océans et de l'habitat, Région des Maritimes, Pêches et Océans Canada) coordonnera la mise en œuvre du plan et suivra les progrès accomplis dans l'application des stratégies et mesures qui y sont proposées. Le Bureau de planification travaillera en étroite collaboration avec d'autres structures du MPO, d'autres instances réglementaires gouvernementales, l'industrie, le milieu scientifique et les organisations non gouvernementales pour mettre en œuvre le plan.

Au fur et à mesure de la mise en œuvre du plan, des rapports d'activités connexes seront présentés régulièrement au Forum de la GIEPNE. Le Plan de conservation du corail sera réexaminé tous les cinq ans (soit d'ici 2010) ou plus tôt si le Plan de GIEPNE l'exige.

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1. Introduction

Purpose of the plan

A Coral¹ Conservation Plan for the Maritimes Region meets several needs. It aims to:

- document what has been done to conserve corals,
- put forward a more comprehensive approach on coral conservation,
- identify issues where more work is needed, including future research needs, and
- build collaboration among a variety of groups to address coral conservation.

The plan briefly describes what is known about the corals found off Nova Scotia, identifies the key issues related to corals and managing human activities, describes existing management measures, and puts forth strategies and actions for learning more about corals and for conserving areas of importance to corals, both those currently identified and areas of importance that may be identified in the future.

Relationship of the plan to Integrated Management and Other Programs and Policies

Oceans Action Plan

The Coral Conservation Plan is related to two pillars of Canada's "Oceans Action Plan." Integrated Oceans Management for Sustainable Development and Health of the Oceans. The integrated management approach outlined in the Oceans Action Plan builds on the direction provided by the *Oceans Act* and "Canada's Oceans Strategy." The Coral Conservation Plan aims to establish clear goals and objectives for decision-making, integrated across sectors. The Oceans Action Plan also notes that protection measures are needed in the oceans, especially the designation of marine protected areas in the ocean to protect the most important, productive and biologically diverse areas and vulnerable species. In our region, certain species of corals are considered vulnerable.

The Oceans Action Plan has identified the Scotian Shelf as a priority area for integrated management planning in Phase 1 of the OAP. The development of a Coral Conservation Plan that includes the Scotian Shelf in its scope is a reflection of its priority in integrated management and planning. Phase 1 of the Oceans Action Plan has resulted in funding for some coral management, conservation and research activities. Phase 2 of the Oceans Action Plan may also provide opportunities for funding. In terms of any funding allocated for corals, priority actions will follow the priorities outlined in the Coral Conservation Plan.

Integrated Management

The Eastern Scotian Shelf Integrated Management (ESSIM) Initiative is developing an integrated oceans management plan for the eastern Scotian Shelf off Nova Scotia. It is a collaborative planning process that involves all interested and affected

¹ The corals found in temperate and sub-arctic waters are often referred to as cold-water corals, deep-water corals and deep-sea corals to distinguish them from their tropical relatives. In this plan, the terms "corals" and "cold-water corals" are used interchangeably for all coral species found off Nova Scotia.

stakeholders: federal and provincial government departments, aboriginal communities, municipal and local planning authorities, ocean industry and resource users, environmental and other non-governmental organizations, and university researchers.

The Coral Conservation Plan is a component of the Eastern Scotian Shelf Integrated Management Plan (the ESSIM Plan).² It contains more detail on management actions related to corals than the broader ESSIM Plan and is referenced within it.

One of the ways to meet the objectives of the ESSIM Plan and the Coral Conservation Plan will be through the identification and management of ecologically and biologically significant areas (EBSAs).³ It is likely that some areas with corals will be identified as EBSAs. However, the identification of EBSAs will not be the only way to meet the objectives for ecosystem-based management and other measures may be taken throughout the region.

Appendix A contains background on the ESSIM Initiative. Other documents about the ESSIM Initiative, including the draft ESSIM Plan and revised ESSIM Plan, are available from the ESSIM Planning Office.

Policy Framework for the Management of Fisheries on Canada's Atlantic Coast

There are other government policies related to particular industries that will influence the implementation of the Coral Conservation Plan. For example, the "Policy Framework for Management of Fisheries on Canada's Atlantic Coast" highlights the roles and responsibilities of resource users in relation to fisheries management. This policy document highlights the need for the participation of fishermen and fishing organizations in decision-making processes related to fisheries.

Funding of the Plan

The ESSIM Planning Office (DFO) is committed to coordinating and implementing the coral conservation plan and has dedicated staff time to this effort. There is funding for different aspects of the coral conservation plan for Phase 1 (2005-2007) of the Oceans Action Plan and efforts will be made to obtain future funding. Activities to be funded in the short term include socio-economic research and some of the research priorities. These activities will be carried out in collaboration with other parts of DFO and outside organizations. The plan identified particular activities as a priority; the high priority activities can be found on page 37 of the plan. The priorities identified in the plan will provide direction in the short term and allow DFO and other government departments and agencies to consider how much long-term funding is required for plan implementation.

Many of the comments on the plan noted the importance of hiring new scientists to work on coral research. A process to hire a new benthic ecologist to work at the Maritimes Region of DFO (Bedford Institute of Oceanography) is in progress. Secure

² ESSIM Planning Office, *Eastern Scotian Shelf Integrated Ocean Management Plan: A Draft for Discussion* (Dartmouth, NS: Fisheries and Oceans Canada, 2005).

³ For a discussion of EBSAs see: DFO, *Identification of Ecologically and Biologically Significant Areas*, Canadian Science Advisory Secretariat Ecosystem Status Report 2004/006.

funding for benthic habitat research has been identified as a priority in the plan and will be pursued.

Scope of the plan

Geographic Scope

The Coral Conservation Plan is for the Maritimes Region, a Fisheries and Oceans Canada (DFO) administrative region. It includes the waters off the Atlantic coasts of Nova Scotia and New Brunswick to the limit of Canada's jurisdiction. This area is larger than the ESSIM Planning Area, which focuses on the eastern Scotian Shelf. There are currently management measures related to corals outside the ESSIM Planning Area and it was considered important to include all the measures in one plan. It is also important to co-ordinate research on corals across the entire region.

Species

Although the entire region is included in the plan, some coral species appear to warrant greater attention than others at this time due to particular characteristics, such as their size, shape, longevity, or limited distribution. In the Maritimes Region, these species are found in the deeper waters off the Atlantic coast of Nova Scotia (including the basins of the Gulf of Maine), at depths below about 150 metres in areas with particular environmental characteristics. In particular, the reef-building coral *Lophelia pertusa* (spider hazards), the bush-like hard coral *Solenosmilia variabilis*⁴, and the large gorgonian corals *Primnoa resedaeformis* (sea corn), *Paragorgia arborea* (bubble-gum coral), *Paramuricea grandis* and *Keratoisis ornata* (banded or bamboo coral) will be the main focus of conservation and management efforts. Other species with limited distributions are also of concern; however, more information is needed on species distributions in general to determine those with restricted distributions.

How the plan was developed

Over the last few years, DFO has developed management measures to protect corals in three different areas of the Scotian Shelf and Slope. A DFO-fishing industry working group provided advice on the design of the management measures. Last year, a working group on corals was formed under the ESSIM umbrella, with the mandate to develop a Coral Conservation Plan for the region. Membership in the working group did not fully reflect all those who had an interest in coral conservation and associated management areas. As a result, the ESSIM Planning Office hosted a one-day corals workshop in October 2004 to discuss coral conservation and gather information for the plan. Representatives from marine industries, government, the research community, and non-governmental organizations attended the workshop. The workshop summary is available from the ESSIM Planning Office. Discussions at the workshop and at other meetings on corals were used to develop the draft plan. The Canada-Nova Scotia Offshore Petroleum Board contributed to sections related to the oil and gas industry.

This draft plan was publicly released at the 3rd ESSIM Forum workshop, February 22-23, 2005. Comments were solicited on the draft plan until June 2005. These

⁴ There are no records of *Solenosmilia variabilis* from the Maritimes Region; however, there are records from the slope of Georges Bank in U.S. waters.

comments were considered by the planning office and a "response to comments" document was released in December 2005. The revised plan was released in the spring of 2006. Copies have been provided to regulators for distribution at meetings with relevant industry sectors and are available to all interested parties from the ESSIM Planning Office.

Why corals?

Coral conservation activities to date have contributed to Canada's efforts to conserve marine biodiversity. The 1997 *Oceans Act* commits the Government of Canada to managing its oceans based on the principles of sustainable development, integrated management, and the use of precautionary, collaborative, and ecosystem approaches. The ecosystem approach to ocean management is a result of greater concern about biodiversity conservation in Canada and around the world. Canada is a signatory to the 1992 *Convention on Biological Diversity*. The Convention requires signatories to "Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes..." (Article 6 (a)).

Tropical corals are a focus of marine biodiversity conservation efforts worldwide. Likewise, cold-water corals have gained increasing conservation attention because some species have life history characteristics that make them particularly sensitive to human activities. Their role or potential role in the ecosystem, of which much remains unclear, has also made them a focus of interest. These characteristics are discussed in more detail in Chapter 3. Although corals have been a focus for marine conservation, other marine species also have life history characteristics that make them more sensitive to human activities. It is likely that future conservation measures will be developed to protect other benthic habitats in the future.

Internationally, greater conservation attention has been focussed recently on deep water benthic ecosystems, including the previously little-known corals found in temperate and sub-Arctic waters. In 2004, the United Nations Environment Program released a report on cold-water coral reefs.⁵ The report called attention to the importance of these habitats and the risk posed to them by human activities. Several countries have implemented conservation measures to protect cold-water corals (see Appendix B).

What is not in the plan

In the process of gathering information for the plan, we asked stakeholders what they thought should be included and what should be the outcomes. This input was valuable and those suggestions were included as much as possible in this document. However, it was not possible to address every suggestion.

Some suggestions require extensive new research and analysis. These include:

- A quantitative accounting of the costs and benefits of coral conservation to the people of Canada
- A statement on the percentage of coral habitats that need to be protected
- Inclusion of all sensitive benthic habitats and a strategy for their protection

⁵ A. Freiwald, J.H. Fosså, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: UNEP-WCMC, 2004).

- A comprehensive plan showing all areas of the Shelf and Slope where protection measures will be put in place.

These suggestions provide good direction for future activities and are included as actions in this or the overall ESSIM Plan. The last two points – inclusion of all sensitive benthic habitats and the development of a conservation systems plan – fit well with strategies listed in the overall ESSIM plan.

Process and Next Steps

Some of the strategies and actions described in the plan are at the strategic planning stage rather than the implementation stage. They have been included because they are considered important but will require further meetings and collaboration to elaborate how to specifically carry out those aspects. The purpose of the plan is to give guidance on the full range of coral issues to oceans managers and others with an interest in corals. This plan will assist all of us in setting direction and developing or furthering programs and projects on coral conservation and research.

If you would like more information on the coral conservation plan or wish to discuss coral research, conservation and related management measures in more detail, please contact the ESSIM Planning Office.



Figure 1. *Paragorgia arborea* (bubble-gum coral) with a sea anemone, Northeast Channel. Photo: Fisheries and Oceans Canada

2. Objectives

The ESSIM Initiative and the Coral Conservation Plan

The Coral Conservation Plan is one part of an overall management strategy to develop and implement benthic ecosystem and habitat protection strategies under the ESSIM Initiative. The vision, guiding principles and management objectives for ESSIM provided guidance for the development of objectives for coral conservation and management on the Scotian Shelf and Slope. As well, the Coral Conservation Plan fits with national objectives to maintain ecosystem health, function, and associated chemical and physical properties.

The conservation and management of benthic communities is a key component of the ESSIM Initiative. The draft ESSIM Plan proposed specific objectives related to the high-level, national objectives. It was discussed at the 3rd ESSIM Forum workshop, February 2005. Community workshops were held at several locations in Nova Scotia to provide a broader opportunity for discussion and feedback on the ESSIM plan. In addition, the ESSIM Stakeholder Advisory Body discussed the draft ESSIM objectives at its meetings. Based on this feedback, the draft objectives were revised and currently the draft objectives related to coral communities are as follows:

- Diversity of benthic, demersal and pelagic community types is conserved.
- Incidental mortality of all species is reduced
- Habitat integrity is conserved

These objectives are directly linked with the objectives that DFO has adopted nationally for ecosystem-based management. The national-level objectives focus on maintaining ecosystem components (communities, species, populations, etc.), productivity of the ecosystem, trophic structure, and physical and chemical properties of the ecosystem.⁶ Within the ESSIM Plan, particular ecosystem components have been identified.

Feedback on the draft coral conservation plan often brought up the importance of adaptive management and the precautionary principle in plan implementation. These are two of the guiding principles for the ESSIM Initiative and thus for this Coral Conservation Plan. The ESSIM guiding principles are listed and defined in Appendix A.

The Corals Conservation Plan and Other Management Plans

Actions related to coral conservation have been included in the most recent Scotia-Fundy groundfish management plan (2002-2007) and will be incorporated into other management plans as necessary. The groundfish management plan is an objective-based plan which relates back to the high-level national objectives to maintain ecosystem health and function. There are strategies within that plan that also fit with the Coral Conservation Plan, namely:

⁶ Fisheries and Oceans Canada, "Habitat Status Report on Ecosystem Objectives," DFO Canadian Science Advisory Secretariat Habitat Status Report 2004/001.

- Protect high diversity coral beds⁷
- Protect benthic communities in the Gully
- Minimize incidental mortalities on non-target species, particularly species at risk.⁸

Like the ESSIM Plan, these objectives may change based on feedback from stakeholders or as new information becomes available.

Objectives for the Coral Conservation Plan

While the ESSIM Plan sets general objectives related to corals, the Coral Conservation Plan provides more detailed objectives and strategies to meet the objectives. These objectives are based on discussions and feedback from the autumn 2004 corals workshop and from other meetings related to coral conservation. The rationale behind the objectives is discussed briefly here. For more detail on several issues related to cold-water corals which informed the development of these objectives, see Chapter 4. These objectives and strategies set out priorities for the next five years.

The coral conservation objectives are sub-divided into conservation, management and research objectives. In Chapter 5, "Strategies and Actions," current and planned actions to meet the objectives will be described.

Conservation Objectives

In general, scientists, ocean users, non-governmental organizations and the public agree that corals and other sensitive benthic communities need particular management measures to ensure their conservation. The following objective and related sub-objectives are proposed to guide the overall conservation and protection of corals in the region.

- Conserve the health and integrity of coral communities
 - Minimize the impacts from human activities on coral communities
 - Protect and, where necessary, restore important coral habitats

Areas of importance to corals have been and will continue to be protected. Other management measures may also be put in place to conserve corals, for example, the identification of corals in environmental assessments and the establishment of best practices⁹ for particular industries or industry sectors.

⁷ "High diversity" coral beds are considered those where the diversity of corals and the species found with them is higher than other parts of the Maritimes Region.

⁸ From: Fisheries and Oceans Canada, *Groundfish Management Plan Scotia-Fundy Fisheries, Maritimes Region, 2002-2007*.

⁹ Best practices are considered environmentally- or socially-responsible methods of carrying out business, which are usually non-regulatory. In fisheries, best practices may include a range of activities, such as gear modifications to avoid catching or entangling non-target species, the investigation of the use of different technologies, or voluntary closures of particular areas at certain times of year. For oil and gas activities, it may mean treating wastes in a different manner in some areas or carrying out detailed research in the area of drill platforms.

How to determine what is "important" coral habitat is an important question. Chapter 5, "Strategies and Actions," provides detail on how important areas will be selected and evaluated, as well as other information on how this objective will be met in the next few years. Important coral habitats will be identified through a scientific evaluation and the criteria used will be consistent with the criteria for identifying ecologically and biologically significant areas.¹⁰ Before protection or restoration measures are implemented, the site evaluation process found on pages 28-30 would be followed.

For the life of this plan, these objectives will be carried out according to the strategies and actions outlined later in the plan. For example, for the sub-objective "Minimize impacts from human activities on coral communities" the strategy to be followed is found on page 26, "Minimize impacts on corals outside the Coral Conservation Areas and the MPA," with the following actions pursued over the life of the plan:

A1 Use fisheries management processes to reduce impacts on corals in general

A1.1 Continue using the fisheries observer program to collect information on coral bycatch

A1.2 Investigate the use of best practices for reducing impacts on corals, including coral bycatch

A2 Use management processes (including environmental assessment processes) in all other relevant ocean use sectors (e.g., petroleum, submarine cable) to ensure that areas with corals (outside CCAs and MPA) are avoided or best practices are used.

A2.1 Ensure corals are identified in environmental assessment process

A2.2 Identify best practices in relation to corals for ocean use sectors

A3 Ensure that research on benthic habitats is carried out appropriately in areas with corals

A3.1 Develop a research protocol with guidance for research in coral conservation areas and other areas with corals.

Management Objectives

Management actions to protect corals will be implemented by a number of regulatory bodies, industry sectors and individuals. In consultations, concerns have been expressed about how decisions will be made on management measures for corals and other sensitive benthic habitats. Strategies and actions to conserve corals will be implemented in the context of the overall ESSIM Plan, its objectives and guiding principles, and the multiple ocean use environment of the region. The following management objectives and sub-objectives will guide decision-making and the general implementation of the plan.

¹⁰ For criteria, see: DFO, Identification of Ecologically and Biologically Significant Areas, Canadian Science Advisory Secretariat Ecosystem Status Report 2004/006.

- Integrate coral conservation requirements into existing management processes.
 - Where necessary, build capacity to address management requirements.
- Implement a flexible and adaptive approach to management and decision-making.
 - Base decision-making on coral conservation on the best available information.
- Consider and evaluate resource use activities when carrying out coral conservation planning and management.
- Provide information to the public on corals and coral conservation measures.
- Collaborate with the international community on cold water coral issues.

Research Objectives

Expanding the scientific and socioeconomic information available to support management actions is a high priority for the plan. Those attending the coral conservation workshop in the fall of 2004 considered that appropriate management is difficult without an ongoing coral research program. Research priorities were identified at the workshop. Some of these priorities are listed below; priorities are discussed in more detail in Chapter 5. As research takes place, an ongoing re-evaluation of the priorities in light of new knowledge will need to occur over the life of the plan.

The following objectives are suggested to guide research activities:

- Support and promote scientific research on corals, including research on:
 - Understanding and assessing the impacts of human activities on corals
 - Distribution of corals
 - Evaluating current and proposed management measures to conserve corals
- Continue to identify research priorities for corals.
- Foster information-sharing and collaboration on coral research.
- Support socioeconomic research related to coral conservation.

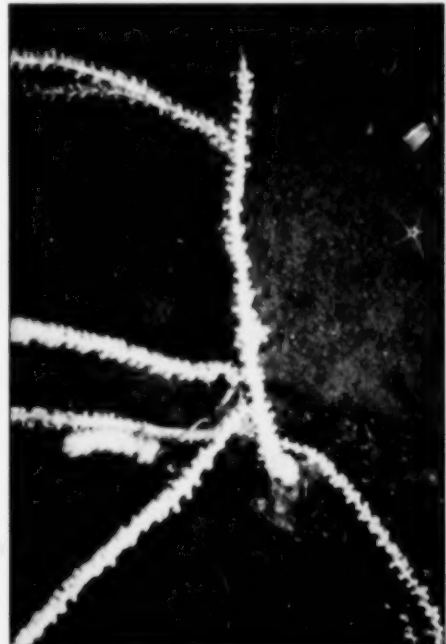


Figure 2. *Keratoisis ornata*, also known as banded coral and bamboo coral.
Photo: Fisheries and Oceans Canada

3. Coral Species

Introduction

Only a brief overview of corals is presented here. Several reports, articles, and theses about Atlantic Canada's cold-water corals have been completed in recent years and the reader is referred to them for a more detailed description of corals in Atlantic Canada (see Appendix C for a list of articles and reports). A description of DFO's recent coral research is in preparation and will be released in early 2005.

While Atlantic Canadian corals have been known to scientists since the late 1800s, concern about their status and vulnerabilities to human impacts have only come to the attention of the public in the last ten years. This concern has fostered a renewed interest in scientific research on corals.

Species found off Nova Scotia and southwest New Brunswick

Two major groups of corals – about 25 to 30 species in total – occur or are thought to occur in the waters off the Atlantic coast of Nova Scotia (Appendix D). At least two or three of those species occur off the southwest coast of New Brunswick in the Bay of Fundy and further directed research may find other species. The species found in the Bay of Fundy are soft coral species which are considered to be less sensitive than other corals. For that reason, the plan focuses on the corals found off the Atlantic coast of Nova Scotia, including the deep basins of the Gulf of Maine.

The *hard or stony corals* (Scleractinia) are found in both colonial and solitary forms. The colonial species build large reef structures, which have been studied in more detail in the tropics. Unlike many of the stony corals of the tropics, the corals found in the cool and often deep waters of the North Atlantic do not have symbiotic algae. Several species of stony corals are known or suspected to occur off Nova Scotia, mostly solitary (non-reef building species) such as the cup coral *Flabellum alabastrum* (Figure 3). One important reef-building species, *Lophelia pertusa* (Figure 4), is known to occur. That species is known to build very large reef structures in the



Figure 3. The cup coral, *Flabellum* sp. Photo taken in the Laurentian Channel, depth of 420 m. Photo: Fisheries and Oceans Canada.



Figure 4. *Lophelia pertusa*, also known locally as spider hazard's coral. Photo taken in the Lophelia Coral Conservation Area. Photo: Fisheries and Oceans Canada



Figure 5. *Paragorgia arborea*, bubblegum coral. Photo taken in the Stone Fence area, Laurentian Channel. Photo: Fisheries and Oceans Canada.

Northeast Atlantic and is associated with many other species of invertebrates and fish.

The *octocorals* (Octocorallia) are a large and diverse group that are distantly related to the stony corals. They include sea fans, sea whips, sea pens (Pennatulacea), and the species known as "soft corals." The Pennatulacea are not included in this plan, which focuses on octocorals from the order Alcyonacea. Off Nova Scotia, some species of octocorals occur in waters as shallow as 8 metres while others are found in the deep waters between fishing banks and along the continental slope. Others are found in both shallow and deep environments. Like the stony corals, some species may form large colonial structures. The largest, such as bubblegum coral (*Paragorgia arborea*) and seacorn coral (*Primnoa resedaeformis*), grow in a bush or tree-like shape and may extend several metres off the sea floor (Figures 5 and 6). Many of the smaller and almost all of the larger species anchor themselves to hard objects on the bottom (such as rocks, boulders, consolidated sediments, other corals, and structures

Box 1. Coral Habitats: Gorgonian Forests, Lophelia Reefs, and Cup Coral Fields

The general descriptions below are helpful in understanding coral habitats; however, they are not all-encompassing. All these habitats may be near each other and corals may also be found outside these habitats.

Gorgonian Forests

Off Nova Scotia, several areas have been identified where concentrations or a diversity of large gorgonian corals are found. Some of these areas are known from reports by fishermen, records from fisheries observers, and old records from museum collections; others are known both from fishermen's reports and recent scientific investigations. Most of the scientific investigations have been limited to areas shallower than about 500 metres in depth, due to the limitations of the equipment used. While there are several areas of gorgonian forests identified on the shelf, these areas are not thought to be widespread.

Lophelia Reefs

Live *Lophelia* colonies have been observed in only one location off Nova Scotia, at the mouth of the Laurentian Channel. A fragment of *Lophelia* was observed in another location and fishermen have collected dead specimens from other locations.¹ Further research may find living reefs in other locations.

Cup Coral Fields

The Scotian Slope contains many areas where cup corals (*Fiabellum* spp.) have been collected and observed. They are also found on soft sediments in basins of the Scotian Shelf and Gulf of Maine. Also found in these habitats are small gorgonian corals that are able to anchor in soft sediments. Other small octocorals may also be found in these areas where there are rocks or boulders to provide holdfasts.

Other Corals

In addition to the three categories described above, many of the species known as "soft corals" (e.g., dead man's fingers *Alcyonium digitatum* and red soft coral *Gersemia rubiformis*) are widespread on the Scotian Shelf where there is suitable rock bottom for attachment and may also be found in other areas attached to pebbles or shell fragments.

¹ P.B. Mortensen, L. Buhl-Mortensen, S. E. Gass, D. C. Gordon Jr., E.L.R. Kenchington, C. Bourbonnais and K. G. MacIsaac, *Deep-water corals in Atlantic Canada: A summary of ESRF-funded research (2001-2003)*. Final report to ESRF (Environmental Studies Research Fund) (Dartmouth, NS: Fisheries and Oceans Canada, in preparation).

such as submarine cables and shipwrecks). Some of the smaller species can anchor themselves on small pebbles or fragments of shell; others have specialized anchoring structures and are able to anchor themselves in soft sediments. Other aspects of coral biology and ecology are discussed in Appendix E.

In addition to the two groups of corals described on the previous page, a third group of corals, the Antipatharians, may also occur off Nova Scotia. They have hard, black skeletons. Antipatharian corals were not thought to occur off Atlantic Canada until recently, when a specimen was collected from the continental slope off Newfoundland.



Figure 6. *Primnoa resedaeformis*, seacorn coral. Photo taken in the Stone Fence area, 286 m depth. Photo: Fisheries and Oceans Canada.

Where corals are found off Nova Scotia

Different species of corals have different life histories, different forms, and thus different habitat preferences and vulnerabilities to human activities. While some of the corals found off Nova Scotia appear to be fairly widespread, others are not. Many of the gorgonian octocorals, such as bubblegum coral (*Paragorgia arborea*) and seacorn (*Primnoa resedaeformis*) have been found only in the channels between the fishing banks and in submarine canyons, areas with preferred habitat characteristics (see Appendix E). These corals may also occur on glacial till or bedrock outcrops in deep basins of the Scotian Shelf and the Gulf of Maine where current patterns carry food regularly by the corals. The reef-building coral, *Lophelia pertusa*, has been reported in few places and has similar habitat preferences.



Figure 7. Areas with corals, identified by fishermen and recently investigated by scientists (based on Breeze et al. 1997, MacIsaac et al. 2000, Gass 2002, Mortensen et al. in prep. See Appendix B for full references).

Participants at the fall coral conservation workshop suggested three categories to describe coral communities: gorgonian forests, *Lophelia* reefs and cup coral fields (see Box 1). These are useful general descriptions but it is difficult to slot each coral species neatly into these groups for management purposes. Depth ranges are not the same for all species, thus the "gorgonian forests" found in some areas may have different species than those of other areas. The habitat characteristics of some areas, such as submarine canyons, may result in all three categories found within a relatively small area.

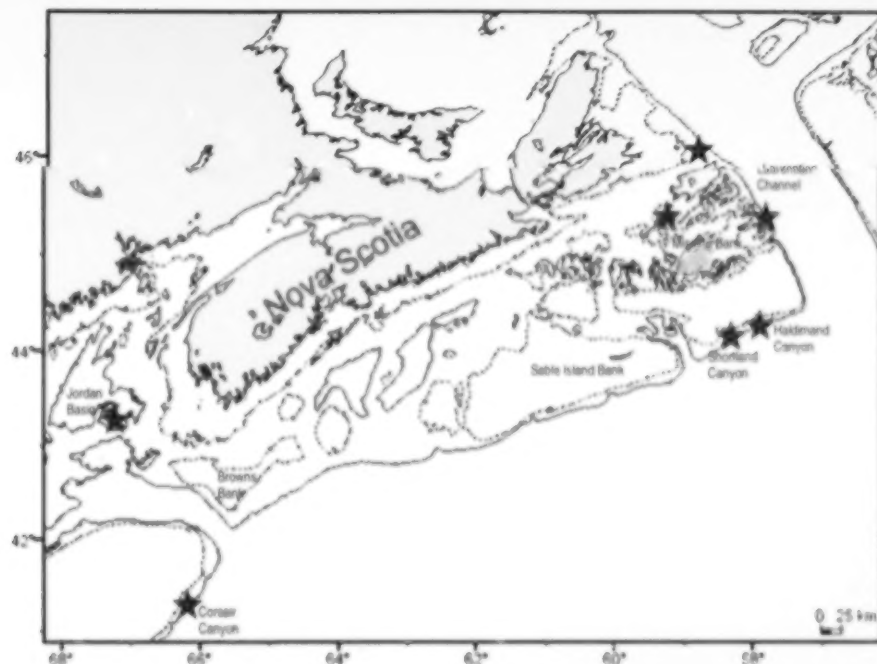


Figure 8. Areas identified by fishermen as having corals and not investigated in detail by scientists (based on Breeze et al. 1997, Gass 2002, unpub. DFO records 2004).

Areas identified by fishermen and investigated recently by scientists

The Northeast Channel, The Gully and the Stone Fence area of the Laurentian Channel have all been identified by fishermen as areas with concentrations of large corals. These observations have been confirmed by scientific research (see Figure 7).

A few other areas along the slope of the continental shelf were identified by fishermen as having concentrations of coral and were later investigated by scientists. However, scientists found only small, solitary corals or isolated soft coral colonies (the "cup coral field" habitat described in Box 1). These investigations were restricted to depths above 500 metres and there may be other species of corals in deeper waters in these areas.

Areas not investigated in detail by scientists

Other areas have been identified by fishermen or through records in museum and scientific collections but no visual surveys of these areas have been conducted by scientists in recent years. These areas include (see Figure 8):

- Jordan Basin¹¹
- Corsair Canyon¹²

¹¹ A recent research mission (June 2005) included stations from Jordan Basin. The results from this research have not yet been fully analysed.

- Logan Canyon
- Shortland Canyon
- Haldimand Canyon
- Holes near Misaine Bank
- Edge of Laurentian Channel near Artimon Bank
- Laurentian Channel near St. Ann's Bank

Many of the museum specimens were collected more than a hundred years ago.

Habitat modeling may assist in identifying preferred habitat within the areas not yet investigated and may also indicate other areas where corals may be present

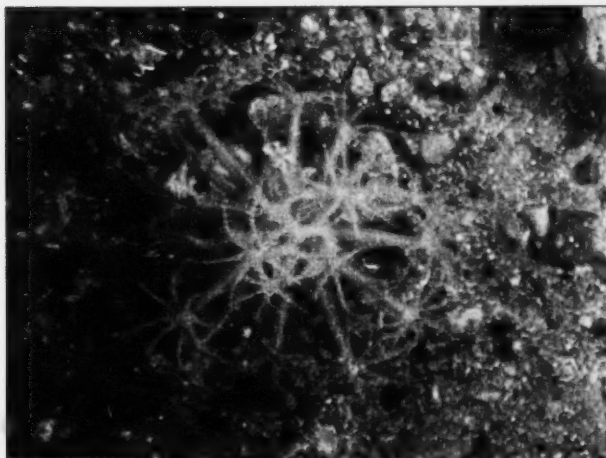


Figure 9. *Acanthogorgia armata*. Photo taken in the Gully area. Photo: Fisheries and Oceans Canada.

¹² Historical observations from Corsair Canyon were included in a study of several submarine canyons found off the northeastern United States (Hecker and Blechschmidt 1980, full reference in Appendix C).

4. Issues in Coral Conservation

Many issues have been raised in relation to coral conservation. Some of the most important issues are discussed briefly in this chapter: the sensitivity of corals to human activities, the lack of information available and research on cold-water corals, the potential impacts of conservation on human activities, and decision-making as related to coral conservation.

Sensitivity of Corals to Human Activities

One of the reasons that cold-water corals have come to the attention of scientists and the public is because of characteristics that make them sensitive to human activities. Impacts caused by human activities can be classified into three main types: **direct removal** or **damage**; impacts caused by **increased sedimentation** in the water column; impacts caused by high levels of **toxins**. These impacts may directly kill the coral or parts of the coral, or leave it susceptible to disease or parasites. The relative sensitivity of different coral species is discussed later in this section. There are potentially other human-caused impacts on corals, such as climate change, that are not well understood.

Direct Removal or Damage

Off Nova Scotia, the human activity that is most likely to cause direct removal or damage is bottom fishing. This is because bottom fishing is a relatively widespread activity in the offshore, while other human activities that impact the bottom are less widespread. Bottom fishing activities may remove the coral colony from the seabed (in whole or in part), or damage coral by dropping or dragging fishing gear through coral, without necessarily taking coral as bycatch.

Globally, it has been shown that corals can be damaged by most types of bottom fishing gear. A recent United Nations Environment Programme (UNEP) report considers active gear – i.e., mobile gear, such as trawls and dredges – a greater threat than passive (fixed) gear, such as lines, pots and traps, and gillnets.¹³ A committee of the U.S. National Research Council Ocean Studies Board reviewed ecosystem effects of fishing and published a report on the effects of trawling and dredging. It concluded that biogenic and stable habitats were most vulnerable to trawling and dredging activities. They also advised that the differing impacts of fishing gear on benthic habitats were a function of the degree of bottom contact and sediment penetration of the gear.¹⁴ The Food and Agricultural Association of the United Nations commissioned a report on the impacts of scallop dredging on benthic habitats and communities.¹⁵ The report noted the limitations of many of the trawling impact studies, with key limitations being their inability to replicate real fishing activities due to research design or the lack of a control site in cases where data from real fishing activities were used. It concluded that based on the available information, the

¹³ A. Freiwald, J.H. Fosså, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: UNEP-WCMC, 2004).

¹⁴ National Research Council, *Effects of trawling and dredging on seafloor habitats* (Washington, DC: National Academy Press, 2002).

¹⁵ S. Løkkeborg, *Impacts of trawling and scallop dredging on benthic habitats and communities*, FAO Fisheries Technical Paper 472 (Rome: FAO, 2005).

most serious impacts on hard bottom habitats were in areas dominated by large sessile fauna with erect organisms such as sponges and corals.

A number of other papers have ranked impacts from mobile gear on benthic habitats to be generally higher than those from fixed gear,¹⁶ although few studies have been carried out on fixed gear and most field studies have been carried out on the impacts of mobile gear. The impacts of mobile gear on corals have been documented, while the impacts of other gear types are less clearly documented.¹⁷ Management measures that allow impacts from fixed gear to be studied and evaluated will assist in overall management of benthic habitats.

Other human activities have the potential to cause damage to corals. If they occur in areas with corals, the direct footprint of exploratory or production drilling for oil and natural gas can damage or destroy corals, as can submarine cable, drill rig or submarine pipeline placement.

In other parts of the world, commercial harvesting of cold-water corals for jewellery or souvenirs presents a threat. Direct harvesting of corals does not appear to be an issue in this region at this time.

Increased Turbidity

Increasing the sediments suspended in the water column may cover coral polyps and keep important life processes from occurring, such as feeding. It may also damage coral tissues through abrasion; in other words, a high volume of fine sand or silt carried by water currents may rub away at the surface of the coral. These impacts may kill corals or negatively impact coral health and growth. More research on the impacts of suspended sediments on cold-water corals is needed.

Several different human activities may cause increased sedimentation in the water column, and may have negative impacts on corals if they occur near or in areas of coral. Exploratory drilling for oil and natural gas may stir up bottom sediments or result in discharges (e.g., rock cuttings) that increase turbidity in the water column or deposit sediments directly on corals. The placement of submarine cables and pipelines may result in sediments in the seafloor being stirred up. Bottom trawling and the use of other mobile fishing gear may also result in turbidity. Other human activities that may result in increased turbidity include some types of scientific research, dredging, and anchoring of vessels in coral areas.

¹⁶ P.J. Auster and R.W. Langdon, The effects of fishing on fish habitat, *American Fisheries Society Symposium* 22 (1999): 150-187. R. Chuenpagdee, L.E. Morgan, S.M. Maxwell, E.A. Norse and D. Pauly, Shifting gears: assessing collateral impacts of fishing methods in U.S. waters, *Frontiers in Ecology* 1 (2003): 517-524. Northeast Region Essential Fish Habitat Steering Committee, Workshop on the Effects of Fishing Gear on Marine Habitats off the Northeastern United States October 23-25, 2001, National Fisheries Science Center Reference Document 02-01 (Woods Hole, MA: NOAA, 2002).

¹⁷ K.A. Johnson, A review of national and international literature on the effects of fishing on benthic habitats. NOAA Technical Memorandum NMFS-F/SPO-57 (Silver Spring, MD: NOAA, 2002)

Toxins

Discharges of toxins in the marine environment affect many parts of the marine ecosystem. For example, accidental discharges of oil may impact corals, as they do other marine plants and animals. Research on the impacts on corals of substances used in oil and gas drilling is being carried out in Europe.

Other activities may also introduce toxins into the marine environment. Land-based activities and outflow from the Gulf of St. Lawrence is a major source of contaminants in the waters of the Scotian Shelf.

Impacts from Other Human Activities

The introduction of invasive species through ballast water may also be a threat to cold-water corals; however, little is known on this subject.

Human-induced climate change may threaten cold-water coral populations in some areas, as the environmental conditions that support coral populations are changed. Climate change is an issue that requires intergovernmental cooperation and coordination. The potential impacts of climate change on cold-water corals are not well understood; however, it is expected that higher sea levels will result in a drop in the alkalinity and calcium carbonate saturation of surface seawater.¹⁸ For warm-water reefs, this is expected to result in a decrease in calcification rates, a factor in coral growth. Although the effects on cold-water reefs have not been studied, the rate of calcification for these animals is also likely to be affected.¹⁹

Sensitivity of coral species

Corals in general are considered to be sensitive species based on their life history characteristics: they are thought to be relatively intolerant of disturbance and slow to recover. The relative sensitivity of different coral species off Nova Scotia has not been formally evaluated. In practice, management measures for conservation have focussed on the species with relatively limited distribution – species that are thought to occur in only a few areas off Nova Scotia, although they may be common within those areas. Management measures have principally focused on the large octocorals *Paragorgia arborea* (bubblegum coral) and *Primnoa resedaeformis* and the reef-building species *Lophelia pertusa*. These large, colonial animals are thought to take longer to recover from disturbance than smaller species. Areas with conservation measures also have other octocorals and small cup corals within their boundaries.

Although the conservation focus has been on the three species mentioned above, more research is needed to better understand the sensitivity of these and other coral species. For some coral species found off Nova Scotia, there are only one or two records. Little is known about many of the species found here. These species may have life history attributes that make them more sensitive to disturbance than the better-known species mentioned above.

¹⁸ Kleypas et al. 1999 cited in A. Freiwald, J.H. Fossá, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: UNEP-WCMC, 2004).

¹⁹ A. Freiwald, J.H. Fossá, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: UNEP-WCMC, 2004).

In general, less conservation priority has been given to the coral species traditionally known as "soft" corals: *Alcyonium digitatum* (Dead man's fingers) and corals from the family Nephtheidae (*Gersemia* spp., *Duva* spp., *Drifa* spp., *Eunephthya* spp.). These seem to be more widespread than the other octocorals. They are usually relatively small and growth and recruitment rates in soft corals in general are relatively fast (although animals found in deep, cold waters generally grow more slowly than those found in shallow, warm waters).

Less conservation priority has also been given to cup corals (*Flabellum* spp.). They appear to be relatively more widespread than the aggregations of gorgonian corals. However, little is known about growth and reproduction in cup corals.

Because little is known about many species, human impacts in areas with concentrations of corals – such as the gorgonian forest and the *Lophelia* reef habitats – are of most concern since:

- aggregations of corals have been found in relatively few areas;
- aggregations of corals significantly influence the physical habitat of the area, providing structure that is used by other species;
- some of the species found in areas with aggregations are slow-growing and long-lived (thus likely to take a long time²⁰ to recover from any human impacts).

Lack of Information and Research on Cold-Water Corals

Although several articles and reports have been published on the corals of Atlantic Canada in recent years, there is still a great deal we do not know about these species. Many aspects of cold-water coral biology and ecology are unknown. Our knowledge of the distribution of corals is incomplete. Not all the areas of Nova Scotia's offshore that have been identified as potentially having concentrations of corals have been researched with scientific equipment, and scientists have been limited to relatively shallow waters (less than 500 metres) in the areas that have been examined. Meetings of the Atlantic Canada Coral Initiative (ACCI) have identified research as an important need for coral conservation, as have DFO scientists and participants in the ESSIM Coral Conservation workshop.

The coral research program carried out by DFO and funded by the Environmental Studies Research Funds (ESRF) is drawing to a close. This program has provided much of the scientific information on corals off Nova Scotia. The end of this program has been raised as an issue of concern by many researchers. Although university scientists have organized research trips, it is more difficult for them to conduct field research without collaboration with coral researchers at DFO because of the limited availability of and costs associated with research vessels.

If further research is carried out, it is likely that we will discover new areas of coral concentration and perhaps even new coral species off Nova Scotia. This means that management of corals will have to adapt to new information. Besides the importance of knowledge for future conservation measures, the lack of ongoing research also makes it difficult to assess the effectiveness of current conservation measures.

²⁰ There has been little research on recovery rates of damaged areas. Some octocoral colonies are more than a century old, while some reef complexes are thousands of years old.

While research on corals in general is considered a priority, particular research topics are considered of more immediate importance. Participants in the coral conservation workshop identified research priorities, which are discussed in more detail in Chapter 5.

Potential Impacts of Conservation on Human Activities

This section briefly reviews some of the major impacts of conservation activities on other human activities.

Fisheries

A major concern related to coral conservation is the potential impact of conservation measures on human activities, particularly fishing. While some conservation measures to protect corals have impacted many different industry sectors, others have exclusively affected the fishing industry. This is partially because bottom fishing is relatively widespread and an activity to which corals are sensitive, and partially due to the different processes used to regulate industry. The environmental assessment process carried out for many activities in the marine environment, though not for fishing, has resulted in restrictions on certain activities due to concerns about impacts on corals.

Some bottom fishing activities overlap with areas known to have concentrations of corals, for example, longline fisheries for halibut in The Gully and the Laurentian Channel, and trawl fisheries for redfish in the Laurentian Channel. In the Northeast Channel, fisheries for several groundfish species carried out by both fixed and mobile gear overlap with coral concentrations. Invertebrate fisheries for lobster and crab also overlap with areas with corals. None of these fisheries are exclusive to areas with corals and they occur throughout the region.

The creation of the Coral Conservation Areas and The Gully MPA has closed some areas to certain types of fishing. This has meant that the fishing activities that occurred there in the past have moved to other areas. Some fishermen have stated that this has meant travelling farther distances to catch fish. Most fishermen aim to maximize their catches and closures of particular areas could potentially lead to greater difficulty in catching individual or fleet quotas. It may also result in fishing on less familiar grounds. The potential operational costs associated with these conservation measures have not been estimated. An estimate of these costs may be of value, particularly where one fishery may be bearing a higher cost from the closures than others.

Fishermen have stated that closing areas where fish are highly concentrated may result in impacts on the ocean bottom over a wider area, as a wider area may be fished in order to meet quotas.

On the other hand, many commercial fish species are highly mobile and can be caught throughout the region. As well, fishing closures may also result in benefits for fishermen. Areas closed to fisheries may be refuges for some commercial species. The closures may create areas with higher populations of some commercial species than the surrounding area. This could result in "spill-over" effects, with high catches just outside the boundaries of fisheries closures or even in areas farther away. As the Coral Conservation Areas are relatively recent, it is not yet possible to assess their

potential benefits for commercial fish. Therefore both the economic costs and the economic benefits of coral conservation are important topics for future research.

Other Human Activities

Coral conservation activities appear to have had few impacts on human activities other than fisheries. Off Nova Scotia, few human activities that directly touch the ocean bottom occur in the deep water areas where coral concentrations have been found. As well, in recent years the environmental assessment process for non-fisheries activities, such as oil and gas, has identified areas known to have concentrations of corals before activities start. This way, the industries are able to avoid these areas before they make a significant investment in carrying out activities in areas with corals. Although new areas with corals are still being identified, industries affecting the ocean bottom (other than fisheries) were not active or had little recent activity in the Coral Conservation Areas and The Gully Marine Protected Area (MPA).

Within The Gully MPA, there is one existing petroleum license: the Primrose field. It was discovered in 1973 and classified as a significant discovery by the CNSOPB in the mid-1980s. To date, the rights to develop this licence have not been exercised. Overall, for non-fishing activities, impacts of conservation have been largely in terms of potential activities foregone, rather than existing activities ending.

Decision-making on Coral Conservation

An important issue that has been brought up at DFO-Industry fisheries meetings, the ESSIM corals working group and the Coral Conservation Workshop, is how decisions are and will be made to conserve corals. Transparency in decision-making was considered an issue that should be added to the plan by participants in the Coral Conservation workshop.

User groups have a high stake in management measures that impact them, while researchers, environmental organizations, and members of the public also want to provide their point of view before decisions are made. Two important policy documents, the *Policy and Operational Framework for Integrated Management of Estuarine, Coastal and Marine Environments in Canada* and *Canada's Oceans Strategy*, commit the federal government to engaging other levels of government, coastal communities, ocean industries, and other ocean interests in integrated oceans management. The Atlantic Fisheries Policy Review document, *A Policy Framework for the Management of Fisheries on Canada's Atlantic Coast*, also invites broad participation in providing advice to policy forums for the management of fisheries.

Chapter 5 proposes steps for DFO to follow before implementing management measures related to coral conservation. Other government departments and agencies may also wish to adopt this process in developing management measures related to corals. While DFO will consider all available information prior to making decisions, the Department also has legislative responsibilities that it must meet.

5. Strategies and Actions

This chapter of the plan provides a recommended set of strategies and associated actions to meet overall coral conservation objectives in the region (as put forward in Chapter 2). The strategies are divided into two sections: A) conservation and management, which focuses on the strategies and actions related to the conservation and management objectives of the plan, and B) research, which focuses on strategies and actions related to the research objectives of the plan. Each section has a brief description of actions to date, a table listing actions for the life of the plan, and, where necessary, further description of future actions in the text. Although the strategies and actions have been divided into two sections, these two sections are related. Actions found under the conservation and management heading may also need research actions to be completed. Similarly, research actions may contribute to conservation and management activities.

As is done in the overall ESSIM Plan, the strategies and actions listed in the tables identify supporting organizations and affected sectors. The tables also describe past or ongoing activities related to the action to document previous activities and assist in planning for activities over the life of the plan. The diagram below illustrates the format of the management strategies and actions:

S1 STRATEGY				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/Status/Priority
A1 ACTION				
A2 ACTION				

Timeline categories:

Short term: Implementation within 1-2 year period

Medium term: Implementation within 2-5 year period

Long term: Implementation beyond 5 years

For the timeline category, please note that some actions will continue well beyond the period they are initiated and first implemented.

Status categories:

Completed: Action is implemented and no follow-up necessary

Ongoing: Action is implemented and the activity or follow-up on the activity (e.g., surveillance, assessment) is ongoing

Initiated: Action has been started but not yet completely implemented

Future: Action is not yet underway

Priority categories:

High: 1st priority for implementation

Medium: 2nd priority for implementation

Low: 3rd priority for implementation

The priority category represents priorities for the plan as a whole.

Conservation and Management Strategies

Conservation of cold-water corals in the Maritimes Region is the responsibility of a number of regulators and the marine user community at large. There are a variety of management tools available in Canada to protect cold-water corals and other ecosystems, including voluntary actions and regulatory measures such as area closures and environmental assessments. It may be appropriate to use different tools, or a different combination of tools, in different areas or to meet different objectives. A list of potential management options available to DFO and other regulators can be found in Appendix F.

The Coral Conservation Plan will take the same approach to management as the ESSIM plan, with objective-based strategies developed that incorporate both voluntary and regulatory measures.

As well as the management tools outlined below, public education and outreach programs are important for the success of all management measures. They will help the public gain a better understanding of the conservation measures that have been put in place and the reasons behind them.

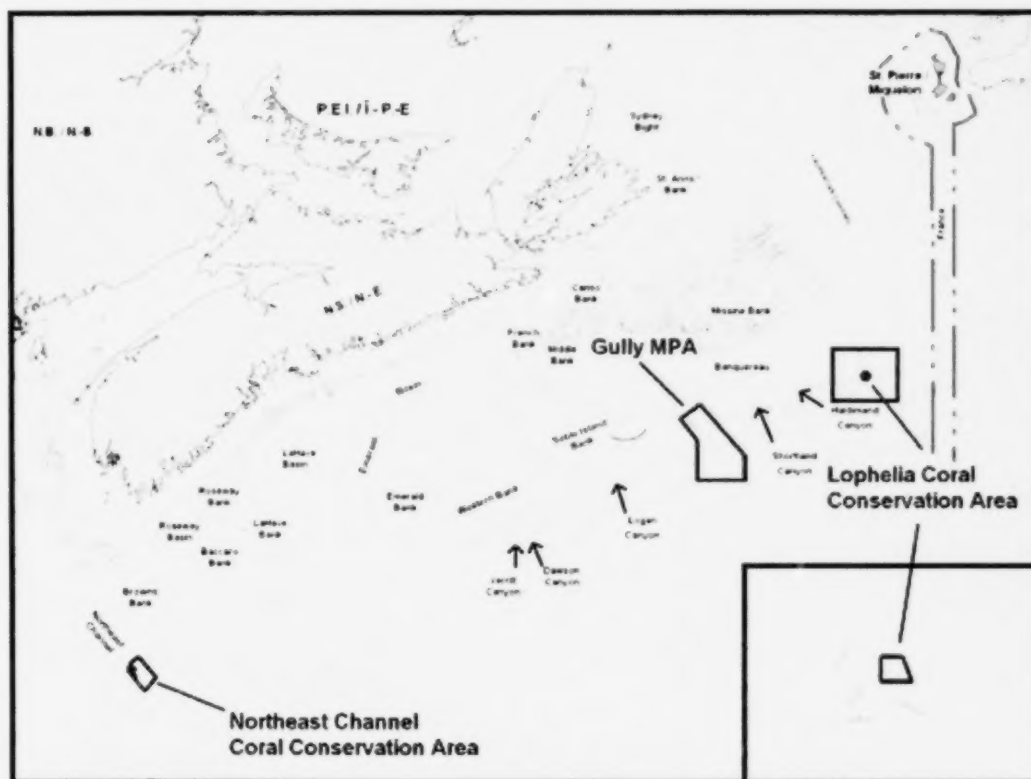


Figure 10. Areas with conservation measures to protect corals.

Actions to Date

Conservation and management actions to date have focussed on protecting key coral areas. This has been done to:

- protect important areas from future damage
- allow recovery of important areas from past damage
- provide for the protection of associated species
- allow for research on corals in areas where little or no human activity is occurring.

Fisheries and Oceans Canada

In consultation with the fishing industry and other interests, DFO has put in place conservation measures to protect three areas of significance for cold-water corals (Figure 10):

- Northeast Channel Coral Conservation Area (2002)
- The Gully Marine Protected Area (2004)
- Lophelia Coral Conservation Area, Laurentian Channel (2004).

The Northeast Channel Coral Conservation Area protects the highest known density of intact large octocorals *Primnoa resedaeformis* (seacorn) and *Paragorgia arborea* (bubblegum coral). The Gully Marine Protected Area protects a diversity of benthic habitats in a submarine canyon, including the highest diversity of cold-water corals in the region. Both of these areas are zoned to allow for some human activities. The Lophelia Coral Conservation Area protects a small area containing living and damaged areas of a *Lophelia* reef complex. Appendix G contains more information on these three areas, including conservation objectives and a description of restricted and permitted activities.

Canada-Nova Scotia Offshore Petroleum Board and the Petroleum Industry

The Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) regulates petroleum activities in Nova Scotia's offshore. Environmental assessments are conducted in advance of activities to assess potential impact on ecosystem components within the area of their proposed operations. Ecosystem components include special areas and species. Corals are often assessed as an individual Valued Ecosystem Component (VEC) or as a component of the benthic habitat VEC within environmental assessments of drilling operations. Benthic habitat assessments are either done by sample collection, ROV surveys, or extrapolation of data collected from adjacent areas.

The CNSOPB will continue to be involved with collaborative efforts to protect cold-water coral. Currently, the Board requires that areas with known aggregations of deep sea coral be avoided during oil and gas drilling activities. Also, if aggregations of deep sea coral are found to occur as the result of an environmental assessment that is conducted following an application for drilling or production, the Board requires mitigation to avoid harming these aggregations. Mitigation may include moving drilling activities from the proposed drilling location.

Other Organizations

Non-governmental environmental groups, fishing industry associations, and research organizations have carried out activities to raise awareness of Nova Scotia's corals

and encourage conservation activities. Many of these groups have also contributed to research (see next section).

Ongoing and Future Conservation and Management Actions

Strategies and actions that are proposed to meet the conservation and management objectives are found in Table 2. As stated in Chapter 2, the conservation and management objectives for the plan are:

Conservation Objectives

- Conserve the health and integrity of coral communities
 - Minimize the impacts from human activities on coral communities
 - Protect and, where necessary, restore important coral habitats

Management Objectives

- Integrate coral conservation requirements into existing management processes.
 - Where necessary, build capacity to address management requirements.
- Implement a flexible and adaptive approach to management and decision-making.
 - Base decision-making on coral conservation on the best available information.
- Consider and evaluate resource use activities when carrying out coral conservation planning and management.
- Provide information to the public on corals and coral conservation measures.
- Collaborate with the international community on cold-water coral issues.

To meet these objectives several strategies and actions will be required. Some of these strategies and actions have already been partially implemented; others will require further action.

Conservation and Management Strategy 1: Support and enhance effectiveness of existing Coral Conservation Areas (CCAs) and Marine Protected Areas (MPA)

Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/ Status/ Priority
A1 Ensure CCAs and MPA are incorporated into ocean use planning and management processes A1.1 Include in fisheries management plans A1.2 Include corals in Gully MPA Management Plan A1.3 Include CCAs and MPA in other sector-based plans and environmental assessments	Coral conservation included in some fisheries management plans Distribution of corals considered in design of marine protected area Gully MPA has been included in environmental assessments	DFO (Oceans/Fisheries Management)/ <i>Other Regulators</i>	All sectors	Short term/ Ongoing/ High
A2 Continue activity monitoring of the CCAs and the Gully MPA A2.1 Surveillance and enforcement of management measures A2.2 Development of integrated fisheries monitoring system A2.3 Work with affected users to address compliance issues associated with area restrictions	DFO fisheries patrols Prosecution of 2003 violation Integrated fisheries monitoring system for Gully in development. Roundtable WG discussions	DFO (Fisheries Management)/ <i>DFO Oceans</i>	Fisheries (conservation areas) All sectors (marine protected area)	Short term/ Initiated- Ongoing/ High
A3 Identify damaging research activities and develop appropriate restrictions for CCAs and MPA A3.1 Restrict DFO Research surveys from CCAs and coral areas of the Gully MPA A3.2 Develop appropriate restrictions and guidelines for other research activities within these areas	Surveys within CCAs restricted since 2003 A process to review research planned for the Gully MPA has been established Review of foreign research applications includes considerations for coral areas	DFO (Science and Oceans)/ <i>Research Community</i>	Research Community (including DFO Science)	A4.1 Short term/ Initiated & Ongoing/ Medium A4.2 Medium term/ Future/ Medium
A4 Review conservation measures on a regular basis (every 2 years) to take into account new scientific and other information		DFO (Oceans)/ <i>Other Regulators</i>	All	Medium / Initiated / High

Conservation and Management Strategy 2: Identify and protect important²¹ coral areas that are not already protected				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/ Status/ Priority
A1 Identify important coral areas (see research strategies and actions for more detail)	<i>See Research Section</i>			
A2 Apply appropriate management measures to protect important coral habitats, if the site evaluation process determines this is necessary.	Three significant coral habitats are currently protected	DFO/Other Regulators	All	Short-Medium/ Ongoing/ High
Conservation and Management Strategy 3: Minimize impacts on corals outside CCAs and the MPA				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/ Status/ Priority
A1 Use fisheries management processes to reduce impacts on corals in general A1.1 Continue using the Fisheries Observer Program to collect information on coral bycatch A1.2 Investigate the use of best practices for reducing impacts on corals, including coral bycatch	Coral I.D. sheets were distributed to Fisheries Observers	DFO (Fisheries Management/ Science/Oceans)	Fisheries	A1.1 Short term/ Ongoing/ Medium A1.2 Long term/ Future/ Medium
A2 Use management processes (including environmental assessment processes) in all other relevant ocean use sectors (e.g., petroleum, submarine cable) to ensure that areas with corals (outside CCAs and MPA) are avoided or best practices are used. A2.1 Ensure corals are identified in environmental assessment process A2.2 Identify best practices in relation to corals for ocean use sectors	Environmental Assessments and Strategic Environmental Assessments conducted for the CNSOPB have included corals	Regulators	All ocean users	A2.1 Short term/ Initiated/ Medium A2.2 Medium term/ Future/ Medium
A3 Ensure that research on benthic habitats is carried out appropriately in areas with corals A3.1 Develop a research protocol with guidance for research in coral conservation areas and other areas with corals.		DFO/Research Community	Research community	Short term/ Future/ Medium

²¹ Details on how areas will be identified as important and how management measures will be put in place are in the text following this table.

Conservation and Management Strategy 5: Provide opportunities for industry and public involvement in conservation and management activities				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/ Status/ Priority
A1 Provide opportunities for public input to decision-making on coral conservation A1.1 Provide opportunities for affected sectors to have input on management and regulatory decisions concerning coral conservation A1.2 Provide opportunities for other interested parties and the general public to have input	Meetings between DFO and fishing industry on conservation areas and MPA. Gully Advisory Committee meetings. Meeting of ESSIM Coral working group re: Lophelia Coral Conservation proposal	DFO/Other Regulators	All	Short term/ Ongoing/ High
A2 Develop outreach plan and disseminate information on corals and coral conservation: A2.1 To affected sectors (e.g., fisheries, oil and gas) A2.2 To the public (e.g. schools, media)	DFO has provided information on closures to fishermen through existing networks. NGOs and research community have provided information to the public	DFO/All	All	A2.1 Medium term/ Ongoing/ High A2.2 Medium term/ Ongoing/ Medium
A3 Pursue opportunities to collaborate with international community on coral conservation	Canada has committed to international agreements on biodiversity Conservation workshop was held at the 1st International Symposium on Deep-Sea Corals (Halifax)	All	All	Medium term/ Future/ Medium

Discussion: Conservation and Management Strategies and Actions

The focus for the conservation and management strategies and actions is to ensure the existing conservation measures are effective and to establish appropriate processes for identifying and establishing future conservation measures that may be needed.

Proposed Site Evaluation Process for Conservation and Management Strategy 2: Identify and protect coral habitats identified as important that are not already protected

How areas are identified as important coral habitat and protection measures are put in place for those areas was identified as a key and potentially contentious issue in most discussions on corals. For that reason, detail is given on Strategy 2: Identify and protect coral habitats identified as important that are not already protected. A site evaluation process (Figure 11) will be used to allow the ecological and socio-economic importance of coral areas to be identified and evaluated. To assist with this process, the plan has identified actions related to science and social science research with the aim of developing a better understanding of the potential impacts of management decisions related to corals.

In general, DFO will follow the steps below before implementing management measures to protect sensitive benthic habitat such as corals.²² Other regulators may also wish to adopt these steps. Management measures could range from an advisory notice on the presence of corals to restrictions on activities in particular areas. *Regulators may not be able to follow all these steps if they are required to implement management measures on an emergency basis to protect habitats and species that are under immediate threat.*

1. Research: Scientific research suggests that a particular site may be important for corals and this information is brought to management attention.
2. Ecological evaluation: The ecological value of the site is evaluated (co-ordinated by DFO). For corals, considerations in evaluating the site will include the following and may also consider other factors:
 - Does the site support particularly sensitive²³ species? Why are the species sensitive?
 - Does the site have a large areal extent of corals? How large is it?
 - Does the site have high concentrations of corals?
 - Is the site an area of high diversity of corals or of species found with corals?

²² The establishment of marine protected areas is a special process that is somewhat different than the process described here, but also provides for an evaluation of the site, an evaluation of human activities related to the site, and consultations with affected sectors and other interested parties (see DFO's *National Framework for Establishing and Managing Marine Protected Areas*, 1998).

²³ As mentioned earlier in the plan, the relative sensitivity of different coral species off Nova Scotia has not been formally evaluated. Management measures have principally focused on the large octocorals *Paragorgia arborea* and *Primnoa resedaeformis* and the reef-building species *Lophelia pertusa*. These large, long-lived colonial animals are thought to take longer to recover from disturbance than smaller species.

- Is the site being negatively impacted by human activities?
 - Are there similar sites already protected?
 - Are the corals found at the site damaged or otherwise impacted by human activities? How much are they damaged?
 - Does the site support species at risk, rare species or appear to play a key role in ecosystem?
3. Activity assessment: After the ecological evaluation, if the site is assessed as being of importance for corals, the human activities occurring in the area are assessed. This assessment will help determine appropriate management measures. Considerations will include the following and may also include other factors:
- What activities may be impacting corals?
 - What activities would be affected if special management measures were put in place?
 - Will activities be displaced? If fishing activity is displaced, can quota be caught elsewhere?
 - What, if any, new activities will result?
 - Which regulators should be involved?
 - What is the socio-economic importance and value of the activities that occur there?
4. Scientific advice: Scientific advice will be sought on appropriate management measures, in light of the activities that occur in the area.
5. Consultations: Advice from user groups and other interested parties will be sought on management measures. Proposed management measures may be presented. Regulators will ensure that consultations are held with affected user groups and members of the ESSIM Forum to discuss options and potential management measures:
- Discussions will be held with user groups identified in the step 3 assessment process through industry meetings (e.g., existing fisheries advisory structures such as the Scotia-Fundy Fishing Industry Roundtable) and where appropriate through community or individual meetings.
 - Consultations will be held with members of the ESSIM Forum. They may also be held with other interested groups, such as researchers and environmental organizations, on their request.
 - If appropriate, a meeting of all interested parties (regulators, industry, others) will be held.
 - If appropriate, a public meeting will be held.
6. Design of management measures: Based on the assessments, scientific advice and consultations, regulators will finalize design of management measures.
7. Approval of management measures: Regulators will follow the approval process for these measures as appropriate within their organization. Within DFO, this will in most cases mean approval at the Regional Director-General level.
8. Implementation: Management measures will be implemented.

9. Evaluation: Management measures will be evaluated on a regular basis to ensure their effectiveness in meeting conservation objectives.

The level of protection at a site could be reduced if it was determined that conservation benefits were minimal and other areas were ultimately found to be more important. It is considered unlikely that this will happen with current conservation areas over the lifetime of the plan. To remove protection of a site, a process similar to what is described above in the site evaluation section will be used.

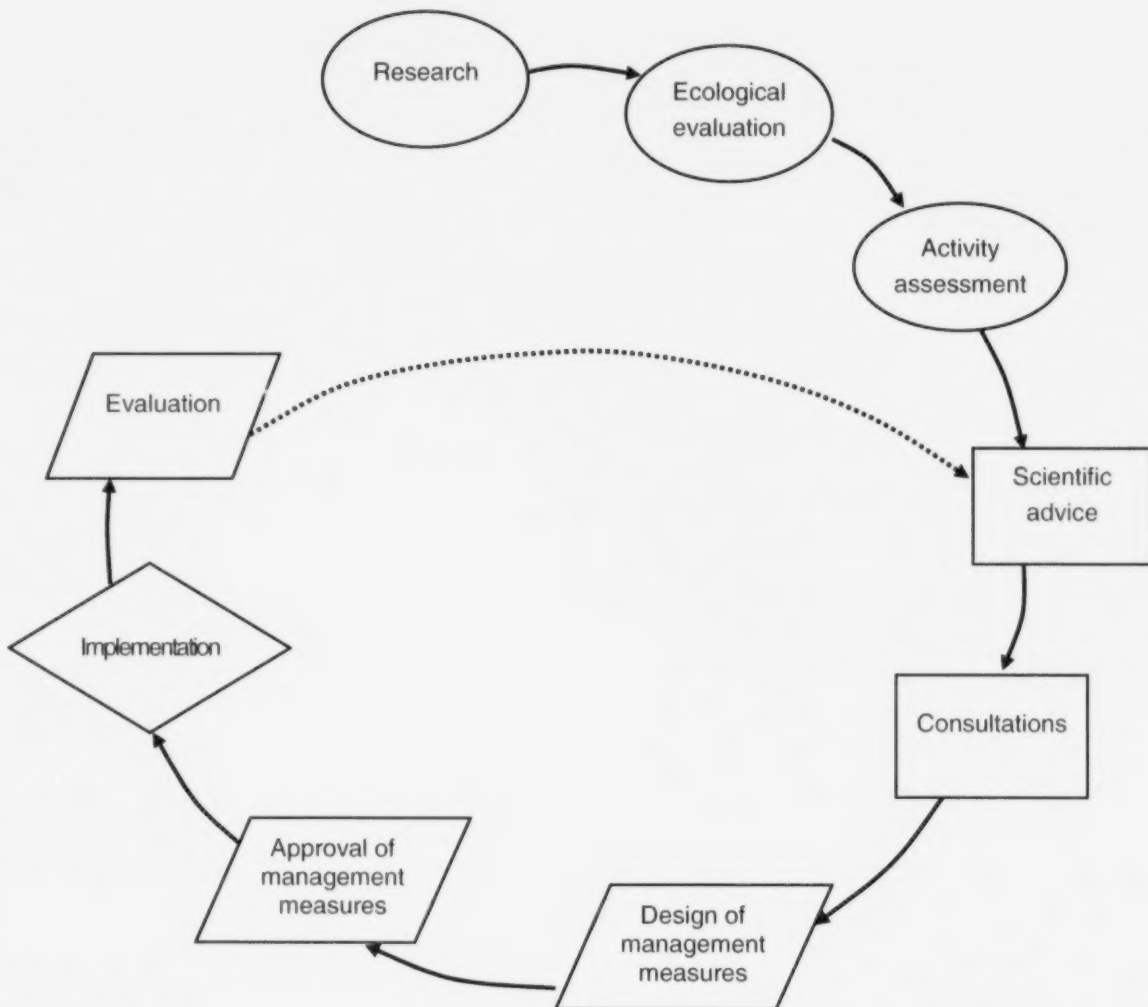


Figure 11. Site evaluation process.

Research Strategies

This section contains a brief description of research activities to date, followed by a table with strategies and actions. The research strategies and actions are closely tied to management needs. Appendix C lists recent publications related to corals of Atlantic Canada, including those resulting from the research described below.

Actions to Date

Activities by Fisheries and Oceans Canada

Fisheries and Oceans Canada (DFO) began collecting information on corals in 1998 and initiated a coral research program in 2000 largely funded by the Environmental Studies Research Funds (ESRF). That program is drawing to a close and the report from that program will be released in early 2006.²⁴ The DFO coral research program conducted four dedicated research surveys between 2000 and 2003 and visited several areas of the Scotian Shelf and Slope. The surveys relied on video and photographs to document the distribution, abundance and condition of corals in these waters, their preferred habitats and some of their associated species. As well, the program obtained data and samples from DFO Research Surveys and the At-sea Observer Program. Live specimens of selected coral species were maintained at the BIO fish lab and used for various studies. Some of this work was in collaboration with university researchers and students. This research has provided scientific information used by DFO to design management measures to protect cold-water corals. The reader is referred to the ESRF report for more information on DFO's research.

Activities by Industry

Individual fishermen and fishing organizations have contributed to studies of corals by providing information on the location of corals and descriptions and samples of different species. This information has been important in establishing promising locations for scientific surveys and for gaining a better understanding of preferred coral habitat. Some of the specimens collected by fishermen have been donated to the Nova Scotia Museum and to scientific collections.

The petroleum industry has contributed to research on corals through funding the Environmental Studies Research Funds (ESRF), a fund supported by the industry; and through site surveys. The financial support provided by the ESRF to the DFO coral research program was key to the success of the program. Oil and gas companies have conducted baseline benthic surveys as part of their EAs for proposed exploration drilling in new deepwater areas. These surveys usually involve the collection of sediment grab samples; analysis for physical, chemical, and biological characteristics; and benthic photographs with a benthic deep sea camera. Some of this data has been donated to the Marine Invertebrates Diversity Initiative or the Nova Scotia Museum of Natural History. Prior to the drilling of deepwater wells, there is typically an underwater Remote Operated Vehicle (ROV) survey. ROV surveys provide additional data about what can be seen on the sea floor.

²⁴ P.B. Mortensen, L. Buhl-Mortensen, S.E. Gass, D.C. Gordon Jr., E.L.R. Kenchington, C. Bourbonnais and K.G. MacIsaac, *Deep-water corals in Atlantic Canada: A summary of ESRF-funded research (2001-2003)*, Final report to ESRF (Environmental Studies Research Funds), in press.

Activities by Universities

Scientists and students at Dalhousie and McMaster Universities have carried out research on many aspects of cold-water corals found off Nova Scotia, including age of corals, associations with other species, preferred habitats, and population genetics. Research using a remotely operated vehicle (ROPOS) was conducted off southwest Nova Scotia. University researchers collaborated on aspects of the DFO research program.

Activities by Non-Governmental Organizations

The Atlantic Coral Conservation Initiative (ACCI) and its predecessors have played an important role in information-sharing and fostering collaboration on research. It is important for local coral researchers to continue to share information. The Ecology Action Centre gathered information on Nova Scotia's corals from museum and scientific collections and carried out research on fishermen's knowledge of coral distribution.

Activities by Many Groups

Many different organizations from the region sponsored or participated in the First International Symposium on Deep-Sea Corals, held in Halifax in 2000. This event brought together deep-sea coral researchers from around the world. Participants from Atlantic Canada also attended the second symposium, held in Erlangen, Germany in 2003 and the third symposium, held in Miami, Florida in 2005.

Ongoing and Future Research Strategies and Actions

Strategies and actions that are proposed to meet the research objectives are found in the following Table. As stated in Chapter 2, the research objectives are:

- Support and promote scientific research on corals, including research on:
 - Understanding and assessing the impacts of human activities on corals
 - Distribution of corals
 - Evaluating current and proposed management measures to conserve corals
- Continue to identify research priorities for corals.
- Foster information-sharing and collaboration on coral research.
- Support socioeconomic research related to coral conservation.

Research Strategy 1: Develop an on-going benthic habitat research program that includes research on corals.				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/Status/Priority
A1 Secure funding for benthic habitat and cold-water coral research. A1.1 Build core capacity within DFO Science A1.2 Pursue funding opportunities with research funding bodies.	Dedicated coral research program (ended 2004) Funding for coral research at universities (mostly ended). Discovery Corridor initiative (Centre for Marine Biodiversity) includes coral areas	DFO and Research Community		Short term/ Initiated/ High
A2 Build and enhance coral information collection in ongoing science surveys A2.1 Identification of corals caught in research trawl surveys A2.2 Continue efforts to identify and to improve accuracy of identification of corals by fisheries observers A2.3 Incorporate coral research into Gully MPA research program A2.4 Encourage coral identification in work carried out by other research programs in the region	Greater effort to identify corals caught by research trawls. Coral identification sheets distributed to fisheries observers.	DFO (Science, Fisheries Management, Oceans)		Short term/ Ongoing/ Medium
A3 Review research priorities regularly (every 2 years)		DFO (Science and Oceans), Research community / DFO (Fisheries Management), Other Regulators, Industry		Short term/ Ongoing/ Medium
Research Strategy 2: Conduct research in support of current management actions				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/Status/Priority
A1 Conduct research to evaluate the effectiveness of CCAs A1.1 Evaluate boundaries of conservation areas A1.2 Track recovery of <i>Lophelia</i> reef complex A1.3 Compare status of corals within conservation areas with those just outside A1.4 Examine impacts of CCAs on other species, including species	Research carried out in June 2005 in Northeast Channel area in support of some of these actions. Further research planned for Northeast Channel, July 2006.	DFO/Research Community		Medium/ Initiated/ High

associated with corals and commercial fish species A1.5 Examine impacts of permitted activities and activities in adjacent areas on the CCAs and A1.6 Examine impacts of CCAs on fishing activities A1.7 Track recovery of Northeast Channel gorgonians				
A2 Conduct research on impacts of human activities on corals and sensitivity of different coral taxa, including types of damage and recovery rates	Some research in Northeast Channel, Gully, and Stone Fence	Research community (including DFO Science)/Other regulators (e.g., CNSOPB), Industry		Medium/Future²⁵/High
A3 Conduct social science research to support management A3.1 Assess socioeconomic costs and benefits of coral conservation for human activities.	Gully Socio-Economic Assessment and review of fishing activities Unpublished review of fishing activities in CCAs	DFO and other regulators/ Research community		Medium/Ongoing/High
Research Strategy 3: Conduct other research in support of management strategies				
Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/Status/Priority
A1 Identify important coral areas A1.1 Build capacity to conduct deep-water research on benthic habitats (i.e., below 500 metres) A1.2 Carry out research on coral distribution (see discussion for details), including creation and testing of predictive models, and evaluate research results against criteria for important coral areas A1.3 Update information gained through traditional ecological knowledge A1.4 Review and compile information on corals from existing databases (e.g., GSC archives, industry archives)²⁶	DFO-DND MOU on use of research submersible DFO research program (2000-2004) 2005 Discovery Corridor Cruise (Gulf of Maine). Further research planned for 2006. Modeling efforts have been carried out (Leverette and Metaxas 2005) Breeze et al. (1997) and Gass (2002) compiled information on corals from fishermen Some information from existing databases has been compiled	DFO (Science and Oceans), Research Community		A1.1 and A1.2 Short term/ Ongoing and Future/ High A1.3 and A1.4 Medium term/ Future/ Low

²⁵ Some research on impacts of human activities has been completed.

²⁶ This action was identified as a priority at the coral conservation workshop. Discussions with those who have carried out research suggests that many existing datasets have been accessed for information on coral distribution. The oil and gas industry may be able to provide other data.

A2 Conduct research on the biology, behaviour, genetics, and ecological role of cold-water corals A2.1 Conduct research on coral reproduction and recruitment A2.2 Collect environmental data at coral sites (e.g., depth, temperature, salinity) A2.3 Conduct research on species associations, richness and diversity on and around corals A2.4 Conduct other research on behaviour, genetics and ecological role of corals	Environmental data collected during 2005 cruise to Jordan Basin and Northeast Channel Work carried out on species associations of <i>Paragorgia arborea</i> and <i>Primnoa resedaeformis</i> (Buhl-Mortensen and Mortensen 2005). Some genetic research has been carried out on coral specimens from Atlantic Canada (Strychar et al. 2005).	Research community (including DFO Science)		A2.1 Medium/ Initiated- Future/ High A2.2, A2.3 and A2.4 Medium/ Initiated- Future/ Medium
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Research Strategy 4: Provide opportunities to share information and collaborate on research

Action	Past or Ongoing Activities	Lead/Supporting Organization	Affected Sectors	Timeline/ Status/ Priority
A1 Continue to share information on research and other activities through the ACCI	Meetings 2002-2004 to discuss research findings	ACCI / Research community		Short term/ Ongoing/ Medium
A2 Share information on coral research to others in the Atlantic Canada through other means	Research findings presented at public lectures, through listservs, etc.	Research community		Short term/ Ongoing/ Medium
A3 Compile and maintain database of coral research off Nova Scotia A3.1 Database with information on areas where corals sampled A3.2 List of publications on corals	Database in progress (DFO) List of publications provided in Coral Workshop Summary	DFO		A3.1 Short term/ Ongoing/ Medium A3.2 2005 list
A4 Share information and collaborate on coral research with the international community (e.g., in the Gulf of Maine)	1 st International Symposium on Deep Sea Corals held in Halifax, 2000. Participation by local researchers in 2 nd Symposium (Germany, 2003) and 3 rd Symposium (Miami, 2005).	Research community		Medium/ Initiated/ Medium

Discussion of Research Strategies and Actions

At the Coral Conservation workshop, several priorities for research were discussed. These can be lumped broadly into two categories: research in support of the existing coral conservation measures, and research aimed at gaining a more complete picture of the distribution of corals and other sensitive benthic habitats. Most of the suggested research in support of existing management measures can be found in the table. However, there was extensive discussion of priorities around future distributional studies that did not fit well in a table format. More detail on proposed future studies can be found below.

Proposed approach for Research Strategy 3: Conduct other research in support of conservation and management strategies

Although it was considered important to map all benthic habitats of the Scotian Shelf and Slope, certain areas were suggested as a priority for research on coral distribution. These were:

Research in areas deeper than 500 metres, particularly:

- Deep habitats near the Lophelia Coral Conservation Area
- Deep habitats in and near the Northeast Channel
- Deep habitats in and near The Gully
- Other deep habitats identified as potentially having corals through fisheries observer, museum collections, or other records.

Research in other priority areas:

- Areas of Jordan Basin identified through Fisheries Observer Records
- Areas near Misaine Bank
- Corsair Canyon
- Other areas that are identified through fisheries observer, museum collections, or other records.

Creating, testing, and refining models based on environmental data and existing distribution data may provide a useful method of identifying the areas most likely to have coral.

The availability of equipment was identified as a key challenge in carrying out research below 500 metres in depth, yet research in deep water areas was considered a high priority. Equipment used in DFO's coral research program was limited to depths of about 500 metres. Participants in the conservation workshop noted that DFO had established a Memorandum of Understanding with Department of National Defence for use of their Remotely Operated Vehicle. It was felt that this and other opportunities to carry out deep water research should continue to be pursued.

Collaboration with American researchers, particularly in the Gulf of Maine, was identified as another opportunity that should be pursued. The Centre for Marine Biodiversity has initiated discussions on collaborative research in the Gulf of Maine.

Summary of High Priority Actions

This section summarizes the high priority conservation, management and research actions found in the tables in this chapter. Implementing these high priority actions is important in meeting the Coral Conservation Plan objectives.

Some of the actions are presently underway and a high priority ranking is recognition of their importance and a recommendation for continuing these activities. Also note that some actions, such as "Apply appropriate management measures to protect important coral habitats," are dependent on accomplishing related high priority actions for research.

High priority actions for conservation and management

- Ensure Coral Conservation Areas and the Gully MPA are incorporated into ocean use planning and management processes, such as fisheries management plans and environmental assessments.
- Continue activity monitoring of the Coral Conservation Areas and the Gully Marine Protected Area, including surveillance and enforcement of management measures and working with affected users to address compliance issues associated with area restrictions
- Apply appropriate management measures to protect important coral habitats, if the site evaluation process determines this is necessary.
- Provide opportunities for input to decision-making on coral conservation
- Disseminate information on corals and coral conservation, particularly to affected activity sectors

High priority actions for research

- Secure funding for benthic habitat and cold-water coral research, including building core capacity within DFO Science and pursuing funding opportunities with external funding bodies.
- Conduct research to evaluate the effectiveness of conservation measures, such as Coral Conservation Areas.
- Conduct research on impacts of human activities on corals and sensitivity of different coral taxa, including types of damage and recovery rates, which will require research on coral reproduction and recruitment
- Identify important coral areas in the region, which will require building capacity to conduct deep-water research and surveys on benthic habitats (i.e., below 500 metres).
- Assess socioeconomic costs and benefits of coral conservation for human activities.

6. Plan Implementation and Review

Plan Approval Process

The Coral Conservation Plan will be considered by the ESSIM stakeholder advisory body and the evolving ESSIM governance processes. However, this process may take some time to implement and management measures and research related to corals are ongoing. Until the ESSIM governance structures are set up, approval for the plan has been sought from the relevant regulators (e.g., DFO, CNSOPB) at the Regional Director-General level. This approval follows a plan consultation period.

Plan Implementation

The ESSIM Planning Office (Oceans and Habitat Branch, Maritimes Region, Fisheries and Oceans Canada) will provide coordination for the implementation of the plan and track the progress of the strategies and actions proposed in the plan. The Planning Office will work closely with other parts of DFO, other government regulators, and industry, research, and non-governmental organizations to implement the plan. The Federal-Provincial ESSIM Working Group will play an important role in coordinating activities and implementing the plan.

As the federal government department primarily responsible for the health of the oceans, as well as for the management of fishing activity and fish habitat, DFO has a large role to play in implementing this plan. However, it is important for other regulators to be involved in conserving sensitive marine habitat, especially as human activities move into deeper waters which have been little impacted by human activity. Copies of the plan will be provided to regulators for their use and distribution.

Researchers, environmental organizations, and fishing groups have played an important role in achieving the coral conservation measures currently in place. The ACCI, with members from many different sectors, has been an important venue for sharing information on corals and different perspectives on coral conservation. It is hoped that these groups will continue to foster collaboration, and provide information and advice to regulators.

Many of the management actions proposed or currently in place are dependent on the provision of scientific advice. For that reason, seeking out funding for continuing research on corals will be a priority as the plan is implemented.

As the plan is implemented, regular reports on activities related to the plan will be provided in updates to the ESSIM Forum.

Plan Review

The Coral Conservation Plan will be reviewed and revised every five years (i.e., by 2010) or sooner if required under the ESSIM Plan. Reflecting the strategy of flexible and adaptive management, actions proposed in the plan may be adapted over the life of the plan to take into account research findings or other new information.

Appendix A. Eastern Scotian Shelf Integrated Management (ESSIM) Initiative

Background on the ESSIM Initiative

Under the 1997 *Oceans Act*, Fisheries and Oceans Canada (DFO) was directed to lead and facilitate the development of integrated management plans for Canada's oceans. Integrated management is a process aimed at addressing the multiple and potential competing uses in the oceans, and will consider impacts from these activities at an ecosystem level.

One of the integrated management projects is the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative. Through ESSIM, DFO is working with a range of stakeholders to develop and implement an integrated ocean management plan on the Scotian Shelf. Three large multi-stakeholder workshops were held in 2002, 2003 and 2005 and other working groups have been formed under the ESSIM Initiative to address specific issues. An internal regional DFO working group on integrated management coordinates regional activities.

In January 2003, a *Strategic Planning Framework for the Eastern Scotian Shelf Ocean Management Plan* was released as a discussion paper for the 2nd ESSIM Forum Workshop. The Framework outlined an approach to the development of an Eastern Scotian Shelf Integrated Ocean Management Plan. It identified the legislative basis for the ESSIM Plan, the vision and guiding principles, and general management objectives (environmental, social, cultural, economic, and institutional). It also identified the area under consideration – namely the eastern Scotian Shelf. Since that paper was released, the geographic area of concern has been reconsidered, and the ESSIM Planning Office has been holding discussions to consider expanding the area of application to encompass the management needs of the entire Scotian Shelf within Canada's Exclusive Economic Zone (EEZ).

After the 2nd ESSIM Forum Workshop, work continued on determining how the management objectives could be put into practice and on developing the first ESSIM Plan. This Plan was released in February 2005 and discussed at the 3rd ESSIM Forum workshop.

The ESSIM Planning Office

Through the mandate of DFO to lead and facilitate integrated management under the *Oceans Act*, part of the Oceans and Coastal Management Division (OCMD), Maritimes Region is functioning as the Planning Office for the ESSIM Initiative. The Planning Office is working with a variety of communities of interest to support their effective participation in the planning process. The Planning Office also took a lead role in the development of the Integrated Ocean Management Plan and related management activities. Contact information for the planning office can be found at the beginning of this document.

Guiding Principles for ESSIM

This list of principles and their definitions are taken from the draft ESSIM Integrated Management Plan (February 2005).

Integrated management: A comprehensive and coordinated approach to planning and decision making for sustainability, based on the balanced consideration of the full range of interests and environmental, social, cultural, economic and institutional objectives for a management area.

Ecosystem-based management: The management of human activities so that ecosystem components, functions and properties are restored and/or maintained at appropriate temporal and spatial scales. Ecosystem objectives are used to identify and set desired ecosystem conditions, measurable indicators for monitoring and evaluation, and operational measures and actions to ensure that conditions are met and maintained.

Sustainable development: A development process that takes into account environmental, economic, social and cultural values in meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Precautionary approach: An evaluation and decision-making process that errs on the side of caution and is applied to cases where there is a risk of serious or irreversible harm, significant scientific uncertainty, and a management decision must be taken. The precautionary approach is applied to decisions with potential ecosystem, social, cultural and economic impacts.

Multiple use management: A component of integrated management that focuses on achieving an acceptable balance of use for a management area, based on agreed-upon environmental, social, cultural, economic and institutional objectives.

Conservation: An approach that ensures the protection, maintenance and rehabilitation of living marine resources, their habitats and supporting ecosystems. Conservation is considered as both a principle to be incorporated into all ocean activities and a use of ocean space and resources in the context of multiple use management.

Collaboration: An open, inclusive and transparent planning, advisory and decision-making process involving all interested and affected parties. Ocean management plans and decisions are based on shared information where those with the decision-making authority and those affected by the decision jointly seek outcomes that meet the needs and interests of all parties to the greatest possible degree. A consensus-based approach is the preferred method for collaborative planning. Under this approach, those with the authority, power and responsibility to implement agreed-upon management plans and measures will be expected to do so as part of their commitment to the planning process.

Adaptive management: The integrated management and planning process is adaptive and responsive to the changing environmental, social, economic and institutional conditions. Ongoing monitoring and regular review of management

plans and actions are used to measure and evaluate progress on management objectives and to identify alterations and revisions required to address changing conditions or improved levels of knowledge.

Stewardship: An ethic of active participation and sharing of responsibility to care for ocean ecosystems and resources as parts of a natural life-support system and to sustain and enhance it for generations to come. Stewardship refers to the wide-range of actions and activities of individuals, communities, groups and organizations acting alone or in partnership to develop and use all natural resources in a sustainable manner, and to maintain the ecosystems on which life depends.

Appendix B. Countries with Conservation Measures to Protect Cold-Water Corals

Adapted from "International review of areas where activities are restricted to protect deep sea corals" prepared by D'Entremont Environmental Ltd in 2004. These are a sample of some of the measures in place to protect cold-water corals.

Australia

In 1975, Australia set up the Tasmanian Seamounts Marine Reserve, which includes 15 out of the approximately 70 seamounts found on the continental slope near Tasmania. Many of the seamounts have deep-water corals, principally the colonial coral *Solenosmilia variabilis*. A management plan for the reserve was put in place in 1999. The reserve uses a vertical zoning system and has two management zones. Bottom trawl fishing is prohibited in both zones. Petroleum and mineral exploration and fishing are not allowed in the Highly Protected Zone (zone below depths of 500 m). Pelagic longline fishing is allowed in the Managed Resource Zone (surface to 500 m depth) and other activities may be allowed in that zone with a permit.

European Union

Azores, Madeira and Canary Islands

Lophelia pertusa reefs are found in great depths (below 1000 metres) at several sites in this area; there are also many seamounts that are home to a variety of coral species. Traditionally, these areas had not been fished by bottom trawl; however, when Portugal and Spain joined the EU, rules for accessing this area changed, starting in August 2004. 2005 update: In September 2005, gillnets, bottom trawling and other dragged nets were banned from depths of 200 m and greater in the area.

Ireland

In December 2003, the Irish Government announced that a number of offshore cold-water coral sites would be designated as Special Areas of Conservation (SAC) under the European Habitats Directive. The reef-building corals *Lophelia pertusa* and *Madrepora oculata* and other suspension feeders (sponges, gorgonian corals, crinoids) are the dominant species. Boundaries of the sites are being determined and formal designation of SACs is expected to take place after a consultation period.

United Kingdom

The Darwin Mounds is a complex of cold-water coral reefs largely made up of *Lophelia pertusa* and *Madrepora oculata* and found about 185 kilometres northwest of the Scottish coast. The UK has proposed that the area be designated as a Special Area of Conservation under the European Habitats Directive. Under an emergency regulation issued in 2003 by the European Commission, fishing vessels are prohibited from using bottom trawls or similar towed nets in the designated area.

New Zealand

Nineteen of 870 seamounts within the New Zealand EEZ have been closed to bottom trawling. Most of the seamounts had little or no fishing history. Many of the seamounts are home to cold-water corals, particularly antipatharian and gorgonian corals, with 30 species identified as endemic.

Norway

The Norwegian government has protected several areas to protect *Lophelia pertusa* reefs. A marine reserve was put in place at Tautra Ridge, site of the shallowest known *Lophelia pertusa* reef. Bottom trawling was banned at 4 other sites. Norway also has general prohibitions against the intentional destruction of cold-water coral reefs.

United States

Alaska

In 1998, an amendment to the Alaska groundfish management plan prohibited trawling in a 52,600 square nautical mile area, at least partially to protect cold-water corals. In 2003-04, several areas in the Gulf of Alaska with red tree corals and other coral species were proposed as Habitat Areas of Particular Concern (HAPC). The HAPC is for areas of special importance that require special protection. In addition, corals and sponges were designated as prohibited species by the North Pacific Fishery Management Council to prevent a fishery for gorgonian corals, used in jewellery, from developing. Update 2005: In 2005, the Council designated several of the coral sites as HAPC and prohibited bottom trawling within them. As well, the Aleutian Islands Habitat Conservation Area was created. The 274,000 square nautical miles area is closed to bottom trawling.

Florida

The cold-water coral *Oculina varicosa* forms thickets in waters 50 to 100 m deep off the central Atlantic coast of Florida. The area was designated a HAPC in 1984 and was closed to mobile fishing gear. In 1995, dropping anchors, chains and grapples in the Oculina Bank HAPC was prohibited and in 2000, the area of the HAPC was expanded.

Appendix C. Articles and Reports on Corals of Nova Scotia (since 1990)

Updated December 2005

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Mortensen, P.B., D.C. Gordon Jr., L. Buhl-Mortensen and D.W. Kulka. Description of a *Lophelia pertusa* reef complex near the Stone Fence in the mouth of Laurentian Channel (Canada) heavily impacted by fishing.

In addition to the reports and articles listed, many posters on Nova Scotia's cold-water corals have been presented at conferences.

Appendix D. Corals found off Nova Scotia

(Based on Mortensen et al. in prep, Gass 2002, MacIsaac et al. 2000, Breeze and Davis 1998, Breeze et al. 1997, Opresko 1980, Hecker and Blechschmidt 1980)

Categories used in columns:

Substrate

Hard: shell, other coral, pebble, cobble, boulder, mudstone, outcrop

Soft: clay, silt

Known or predicted depth

Shallow = Off NS, usually < 150 m

Deep = Off NS, usually 150 - 300 m

Very deep = Off NS, usually > 300 m

Known occurrence off NS

No records

One record

One area

Few areas

Widespread

Approximate size range

Small = < 35 cm

Large = > 35 cm

Shape

Encrusting = e.g., *Trachythela rudis*

Lobed = e.g., *Alcyonium digitatum* (dead man's fingers)

Hydroid-like = e.g., *Trachythela rudis*

Broccoli-like = e.g., *Gersemia* spp. (sea cauliflower)

Whip-like = e.g., *Radicipes* spp.

Bush-like = e.g., *Acanella arbuscula*

Tree-like = e.g., *Paragorgia arborea* (bubblegum coral)

Cup-like = e.g., *Flabellum* spp. (cup corals)

Horn-like = e.g., *Javania cailletti*

Recently documented observation

DFO = Observed during DFO coral research program, 1998-2004

Scientific Name* Common Name	Substrate, Known or predicted depth, Known occurrence off NS	Approximate size range Shape	Other Comments	Recently documented observation
Octocorals (Soft corals, leather corals, gorgonian corals, sea fans)				
<i>Acanthogorgia armata</i>	Hard substrate Deep, very deep Few areas	Small Bush-like	Found on cobbles, boulders	DFO
<i>Alcyonium digitatum</i> Dead man's fingers	Hard substrate Shallow Widespread	Small Lobed	Short, thick lobes	unknown – widespread
<i>Anthomastus grandiflorus</i>	Hard and soft substrate Deep, very deep Few areas	Small Bush-like	Found on small fragments of shell and pebbles in areas of soft substrate	DFO

Scientific Name* Common Name	Substrate, Known or predicted depth, Known occurrence off NS	Approximate size range Shape	Other Comments	Recently documented observation
<i>Anthomastus agassizii</i>	Hard substrate Very deep One area	Small Bush-like	Found on outcrops in Corsair Canyon. May be more common in US waters	Most recent: pre-1980 dive of Alvin submersible
<i>Anthothela grandiflora</i>	Hard substrate Deep, very deep Few areas	Small Encrusting, bush- like	Found on shells, stones, other corals. Two forms: some are encrusting, others are bush-like	DFO
<i>Radicipes challengerii</i>	Soft substrate Unknown Unknown	Unknown Whip-like	Anchors in soft sediment	DFO
<i>Radicipes gracilis</i>	Soft substrate Deep, Very deep Few areas	Large Whip-like	Anchors in soft sediment May be widespread on the slope	DFO
<i>Trachythela rudis</i>	Hard substrate Unknown One record	Small Encrusting, hydroid-like	Observed on <i>P. resedaeformis</i> skeleton Encrusting form with hydroid-like polyps	DFO
<i>Acanella arbuscula</i> Banded coral	Soft substrate Deep, very deep Few areas	Small Bush-like	Anchors in soft sediment May be widespread on the slope	DFO
<i>Keratoisis ornata</i> Gold-banded coral Bamboo coral	Hard substrate Deep Few areas	Large Tree-like	Type specimen from NS; and may be unique to Scotian Slope. Shape is sparsely-branched, small tree.	DFO
<i>Drifa glomerata</i> **	Hard substrate Deep See other comments	Small Broccoli-like	The species of the family Nephtheidae are difficult to distinguish from one another and the taxonomy is unclear. At least one of these species may be common in appropriate habitats.	DFO
<i>Duva florida</i> **	Hard substrate Deep Few areas; see other comments	Small Broccoli-like		DFO
<i>Eunephthya fruticosa</i> **	Hard substrate Deep See other comments	Small Broccoli-like		None confirmed: old specimens in scientific collections

Scientific Name* Common Name	Substrate, Known or predicted depth, Known occurrence off NS	Approximate size range Shape	Other Comments	Recently documented observation
<i>Gersemia rubiformis</i> ** Sea cauliflower, sea strawberry, red soft coral	Hard substrate Shallow, deep Widespread	Small Broccoli-like		DFO
<i>Paragorgia arborea</i> Bubblegum coral	Hard substrate Deep Few areas	Large Tree-like	Found on cobbles, boulders, outcrops	DFO
<i>Paramuricea grandis</i>	Hard substrate Deep, Very deep Few areas	Small-large Bush or tree-like	Difficult to distinguish from <i>P. placomus</i> Known from few areas and very few records from those areas.	DFO
<i>Paramuricea placomus</i>	Hard substrate Deep, Very deep Few areas	Unknown Bush-like	Difficult to distinguish from <i>P. grandis</i> ; may be smaller. Known from few areas and very few records from those areas	DFO
<i>Primnoa resedaeformis</i> Seacorn coral Rice coral	Hard substrate Deep Few areas	Large Bush or tree-like	Found on cobbles and boulders. Found in few areas but common in those areas	DFO
<i>Anthelia borealis</i>	Unknown	Small Unknown		Atlantic Reference Centre Collection
Antipatharia (black corals, thorny corals)				
<i>Bathypathes</i> sp.	Unknown Very deep No records	Large Bush-like	One record off NF, depth between 730 and 900 m	None off NS
Scleractinia (stony corals, hard corals)				
<i>Dasmomilia lymani</i>	Soft substrates Unknown No records	Small Cup-like	Records from Georges Bank and southwards	None off NS
<i>Desmophyllum dianthus</i>	Hard substrates Unknown No records	Small Horn-like	Records from Georges Bank and southwards and from NF	None off NS
<i>Lophelia pertusa</i> Spider hazards	Hard substrate Deep Few records	Large Banks/reefs	Shell, pebble may be sufficient hard substrate. One record of reef complex, fragments from other areas. Extensive damage by fishing gear observed	DFO

Scientific Name* Common Name	Substrate, Known or predicted depth, Known occurrence off NS	Approximate size range Shape	Other Comments	Recently documented observation
<i>Solenosmilia variabilis</i>	Hard substrate Unknown No records	Large Bush-like	Records from Georges Bank and southwards	None off NS
<i>Flabellum alabastrum</i> Cup coral	Hard substrate Deep, Very deep Widely distributed along slope	Small Cup-like	The three <i>Flabellum</i> species can be difficult to distinguish; <i>F. alabsatrum</i> is the most common. It was not possible to identify to species some of the <i>Flabellum</i> spp. observed during the DFO research program. There may be other species not listed here and there may be synonymies. <i>Flabellum</i> spp. are found on small stones in areas of soft substrate.	DFO
<i>Flabellum angulare</i> Cup coral	Hard substrate Very deep See other comments	Small Cup-like		DFO
<i>Flabellum macandrewi</i> Cup coral	Hard substrate Very deep See other comments	Small Cup-like		DFO
<i>Javania cailleti</i>	Hard substrate Unknown One record	Small Horn-like	The record in NS waters is from 1885, Stone Fence area. There is a record in US waters near Georges Bank	off NS: last observed 1885

*Taxonomy is from the European Register of Marine Species (Website: erms.biol.soton.ac.uk).

**It was not possible to identify to species some of the Nephtheidae observed during the DFO research program; there may be other species not listed here.

References are listed in Appendix C, with the exception of:

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Appendix E. Basic Coral Biology

Structure

Depending on the species, corals may consist of a single individual – a solitary polyp with a mouth surrounded by tentacles – or they may be colonies of tens to thousands of polyps sharing a skeletal structure. Corals are sessile, in other words, they are anchored to the ocean bottom and cannot move around.

Diet

Corals are filter feeders. They use their tentacles to capture plankton and particles of decomposing organisms that drift by them.

Growth and Reproduction

There is relatively little information on coral growth and reproduction. The large colonial corals that are found in deep waters off Nova Scotia are known to grow relatively slowly, thus animals a metre in height may be more than a hundred years in age. Corals may only reproduce periodically, when there are certain environmental conditions, rather than having set reproductive periods each year. The slow growth rate and potentially few reproductive episodes may make it difficult for corals to recover from damaging human activities.

Habitat

Corals are found in many marine environments off Nova Scotia. However, large, long-lived colonial corals, such as bubble-gum coral (*Paragorgia arborea*), seacorn coral (*Primnoa resedaeformis*) and the reef-building coral *Lophelia pertusa* seem to be concentrated in only a few areas. These areas correspond with the characteristics of areas where cold-water corals are found in other parts of the world, as described in a recent UNEP report (Box 2). Areas with preferred characteristics have:

- no disturbance of the seabed from storms
- strong bottom currents
- boulders, cliffs, ridges, hills, or seamounts or human structures such as wrecks and cables
- water flow funnelled through channels, straits, or underwater canyons
- nearby areas with high plankton levels that provide food for the corals.

Box 2. Characteristics of areas with Cold-Water Coral Ecosystems:¹

- The seasonal storm wave base does not affect the seabed.
- Strong topographically guided bottom currents prevent deposition of sediments, thereby creating current-swept hard substrate that facilitates colonization by habitat-forming corals. Generally, these grounds are pre-existing topographic highs of various scales that form obstacles in the current path: they can be boulder fields, moraine ridges, drumlins, the flanks of oceanic banks, seamounts, sedimentary mounds and occasionally artificial substrates such as wrecks and oil rigs.
- The flow of water is funnelled through narrow passages such as straits (e.g. Florida Strait, Strait of Gibraltar, Cook Strait (New Zealand)) or channels, fjord troughs (e.g. in Scandinavia, New Zealand and Chile) and submerged canyons and gullies.
- Nearby nutrient-rich waters stimulate the development of high phyto- and zooplankton levels, providing a major food source for the coral communities.

¹A. Freiwald, J.H. Fosså, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: United Nations Environment Programme-World Conservation Monitoring Centre), 2004.

Species found with Corals

Corals provide habitat for many marine species. Brittle stars, anemones, sponges, redfish, and many species of crustaceans (e.g., shrimps, isopods and amphipods) have been found on and among corals off Nova Scotia.²⁷ There are few species that live only with corals. However, many studies have shown that areas of the seafloor with habitat complexity, such as the presence of certain structure-creating plants and animals (e.g., plants, corals, and sponges) or the presence of physical features such as cliffs and boulders are important for fish populations and biodiversity.²⁸ The UNEP report on cold-water corals noted that the habitat complexity provided by corals was attractive for many marine species, including commercial species.²⁹

²⁷ K. MacIsaac, C. Bourbonnais, E. Kenchington, D. Gordon Jr. and S. Gass, Observations on the occurrence and habitat preference of corals in Atlantic Canada. In: *Proceedings of the 1st International Symposium on Deep Sea Corals*, Halifax, NS, July 30 to August 3, 2000 (Halifax, NS: Ecology Action Centre and NS Museum, 2001) pp. 58-75; L. Buhl-Mortensen and P.B. Mortensen, Crustaceans associated with the deep-water gorgonian corals *Paragorgia arborea* (L., 1758) and *Primnoa resedaeformis* (Gunn, 1763), *Journal of Natural History* 38 (2004): 1233-1247.

²⁸ National Research Council, Committee on Ecosystem Effects of Fishing, *Effects of Trawling and Dredging on Seafloor Habitat* (Washington, DC: National Academy Press, 2002); S.F. Thrush, J.E. Hewitt, G.A. Funnell, V.J. Cummings, J. Ellis, D. Schultz, D. Talley, and A. Norkko, Fishing disturbance and marine biodiversity: role of habitat structure in simple soft-sediment systems, *Marine Ecology Progress Series* 221 (2001): 255-264.

²⁹ A. Freiwald, J.H. Fossá, A. Grehan, T. Koslow and J.M. Roberts, *Cold-water coral reefs* (Cambridge, UK: UNEP-WCMC), 2004.

Appendix F. Management Tools

There are a variety of management tools in Canada to protect cold-water corals and other ecosystems. It may be appropriate to use different tools, or a different combination of tools, in different areas or to meet different goals and objectives. The Coral Conservation Plan will take the same approach to management as the ESSIM plan, with objective-based strategies developed that incorporate both voluntary and regulatory measures.

As well as the management tools outlined below, public education and outreach programs are important for the success of all management measures. They will help the public gain a better understanding of the conservation measures that have been put in place and the reasons behind them.

Voluntary Measures

Voluntary measures, such as agreement to avoid certain areas, may be a useful tool where risks to corals are low or where compliance with the voluntary measures is expected to be high. Voluntary measures require a high level of cooperation among users and may be difficult to achieve. They should be monitored for effectiveness and accompanied by education and outreach efforts to maximize success. Voluntary measures include formal or informal agreements by one or more industries to avoid specified areas with corals.

Voluntary measures may be implemented through *Codes of Practice* or management plans developed by particular industries, in conjunction with regulators. These may specify how to carry out activities in certain geographic areas, or provide general guidelines for carrying out activities.

Regulatory Measures

Fisheries and Oceans Canada

The *Atlantic Fishery Regulations* under the *Fisheries Act* may be used to implement area closures by variation order or within license conditions. These closures may specify certain gear types or vessel class. Penalties for contravening the order or the license condition are specified. The Northeast Channel Coral Conservation Area and the *Lophelia* Coral Conservation Area in the Laurentian Channel are closures under the *Fisheries Act*.

The tools available under the *Oceans Act* may be used to address activities from a variety of sectors. The *Oceans Act* may be used to establish marine protected areas (MPAs). MPAs may have prohibitions on specific activities within the entire MPA or within zones established within the MPA. Integrated management plans may also be developed under the *Oceans Act* that set out requirements for particular areas. These integrated management plans will require collaboration with other oceans regulators to ensure that appropriate regulations are developed. Integrated management plans may also include voluntary measures such as those described above. In addition, the *Oceans Act* allows for the development of regulations for marine environmental quality standards. In general, it is expected that these standards will be developed through the integrated management planning process.

There are currently no coral species listed under the *Species at Risk Act*. As more is learned about corals off Nova Scotia, there is the potential that certain species may be assessed as species at risk. Once a species is legally listed, certain prohibitions apply in order to protect species at risk.

Other Government Departments and Agencies

Canada-Nova Scotia Offshore Petroleum Board

The Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) is responsible for protection of the environment during all phases of offshore petroleum activities, from initial exploration to abandonment. The Board's environmental assessment process starts at the Call for Bids stage, during which environmental concerns or issues are identified. These issues may be addressed through future project-specific environmental assessments, or by the Board deciding not to accept bids on a particular parcel. All subsequent projects, including seismic programs and exploratory wells, must undergo an individual environmental assessment prior to approval by the CNSOPB.

The Board is now officially a Federal Authority under the *Canadian Environmental Assessment Act* (CEAA), and as such conducts assessments according to the regulations of the Act. The Board is also involved in initiatives led by the Department of Fisheries and Oceans (DFO) related to marine protected areas and integrated management planning under the Oceans Act. As well, the Board has signed memorandums of understanding with both the Department of Fisheries and Oceans and Environment Canada, and consults with scientific experts from these departments on relevant issues.

Parks Canada Agency

The Parks Canada Agency has the responsibility for designing a system of national marine conservation areas (NMCAs). They are intended to represent the full range of Canada's marine ecosystems. Activities are restricted within these areas, with some activities permitted in some areas. There is the potential that corals may be protected in NMCAs. No NMCAs are planned for the Scotian Shelf at this time.

Other Departments and Agencies

Other departments and agencies may regulate and restrict activities in the sectors that they have the legislated responsibility to regulate. They may require certain operating practices in specific geographic areas. This could include areas with corals.

For all government regulators, environmental assessment processes of activities may be used to identify special areas and to set up specific requirements for those areas.

Appendix G. Coral Conservation Areas and Gully Marine Protected Area

Northeast Channel Coral Conservation Area

Overview

The Northeast Channel area has been a focus of coral conservation efforts in the region since the late 1990s, including recommendations for fisheries closures to protect corals. In June 2002, DFO established a Coral Conservation Area in a portion of the Northeast Channel (parts of NAFO Divisions 5ZE and 4X.). The Conservation Area (Figure 12) contains the highest known density of intact large octocoral (bubblegum and seacorn coral) colonies in Atlantic Canada. Signs of fishing impact were visible as broken live corals, tilted corals, and scattered skeletons. The area selected was based on an evaluation of the results from the 2000 and 2001 visual surveys by DFO and Dalhousie University. As a precautionary measure the southeastern boundary was extended to 1200 metres in depth to capture additional potential coral habitats.

The Northeast Channel is an important fishing area targeted by otter trawl, longline, and gillnet vessels. The Conservation Area was designed with input from the fishing

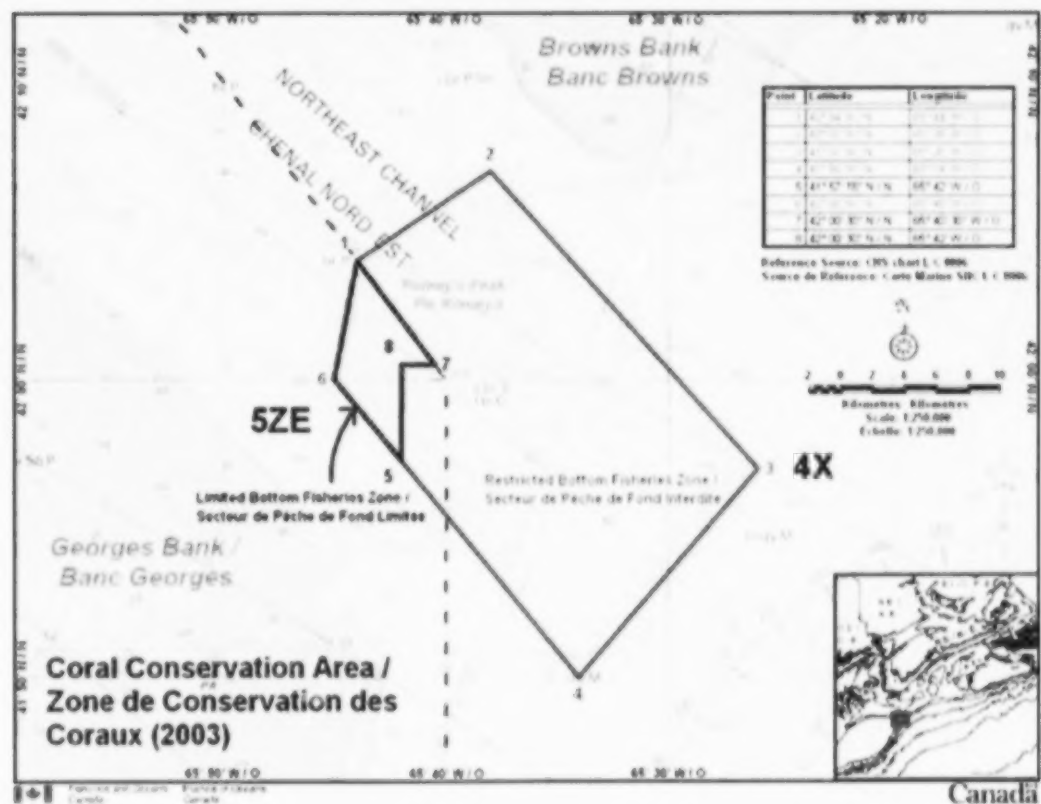


Figure 12. Northeast Channel Coral Conservation Area

industry through a working group established under the Scotia-Fundy Fisheries Roundtable. Boundary proposals were discussed and an evaluation of the potential effects on fisheries in the region was conducted. As well, relevant fisheries advisory meetings evaluated the proposal and a special meeting of the Shelburne County Fixed Gear Quota Group was held in the spring of 2002 in Shelburne to discuss the issue. Concerns over the impact of a closure on a small group of longliners who currently fish the area were raised. Adjustments were made to the design of the conservation area, reducing the effect on some fisheries while still protecting cold-water corals. The Coral Conservation Area does not include all known areas of the Northeast Channel with corals.

There are no oil and gas activities in the area, as the Coral Conservation Area is found within the pre-existing Georges Bank moratorium area.

Objective

Protect high densities of intact octocorals (bubblegum and seacorn coral).

Legislation/Regulations

License conditions and variation orders issued under the *Fisheries Act (Maritimes Fishery Regulations)* restrict bottom fishing in this area.

There is a moratorium on oil and gas exploration and production activities in the Georges Bank area (including the Northeast Channel) under the *Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Acts*. The moratorium is in place until 2013.

Size and restrictions

The Coral Conservation Area is a 424-square kilometre area with two zones (Figure 12): a restricted bottom fishing zone (about 90 percent of the area) and a limited bottom fishing zone (about 10 percent of the area). The highest density of corals, as observed in scientific surveys, is found in the restricted fishing zone. The limited bottom fishing zone is open to longline fishermen who carry Fisheries Observers while the restricted bottom fishing zone is closed to all bottom fishing activities (groundfish and invertebrates). The purpose of the limited bottom fishery is to gain a better understanding of the impacts of this type of fishing on corals, and on recovery rates. The southern boundary between the two zones was adjusted in 2003 by Fisheries Management staff.

Lophelia Coral Conservation Area

Overview

In September 2003, DFO scientists observed mounds of the reef building coral *Lophelia pertusa* (spider hazards) at the Stone Fence. This area, at the mouth of the Laurentian Channel, is the only known location with living *Lophelia pertusa* colonies on Canada's Atlantic coast. The corals and nearby seabed show signs of significant damage from fishing gear and recovery of the reef complex may take decades. *Lophelia* reefs are sites of high biodiversity in the Northeast Atlantic.

The Lophelia Coral Conservation Area (Figure 13) was put in place in June 2004 and closed a small area surrounding the reef to all bottom fisheries. The reef is centred in

the closure with roughly a 1-nautical mile buffer around it. The closure largely affects otter trawl vessels that fish for redfish in the area and longline vessels fishing for halibut. A fishing industry advisory group provided input into the design of the fisheries closure. A meeting with the ESSIM Corals working group was also held for comments on the proposal. The closure does not include all sites in the Stone Fence/Laurentian Channel area with corals.

Objective

Protect the *Lophelia pertusa* reef complex from further damage and allow for recovery.

Legislation/Regulations

License conditions and variation orders issued under the *Fisheries Act (Atlantic Fishery Regulations)* restrict bottom fishing in this area.

Petroleum exploration and production licenses have not been issued by the Canada-Nova Scotia Offshore Petroleum Board for the seabed within the Conservation Area.

Size and restrictions

The 15-square kilometre area is closed to all bottom fisheries.

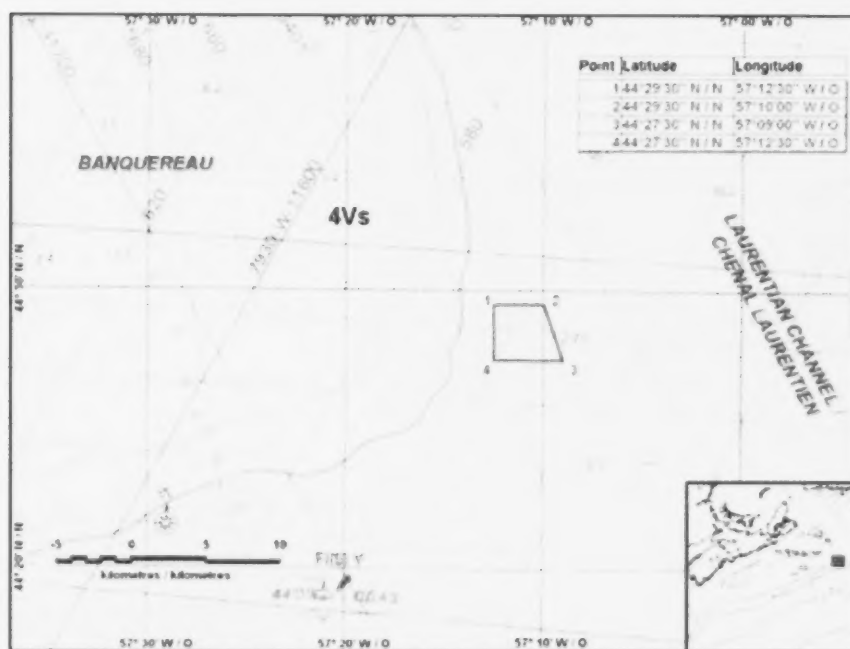


Figure 13. Location and co-ordinates of Lophelia Coral Conservation Area.

The Gully Marine Protected Area

Overview

The Gully Marine Protected Area (MPA) was designated in May 2004. It protects a large, underwater canyon with many diverse habitats. The Gully has the highest known diversity of corals in Atlantic Canada and includes species not found elsewhere on the Scotian Shelf. There are few signs of damage to the corals observed in the canyon.

The MPA has been divided into zones (Figure 14), with different management measures for each zone. Corals are present in most parts of the canyon, however the distribution and habitat of most species largely corresponds to Zones 1 and 2 of the MPA.

An advisory committee provided input to DFO on the development of the MPA and continues to provide feedback on the development of the MPA Management Plan.

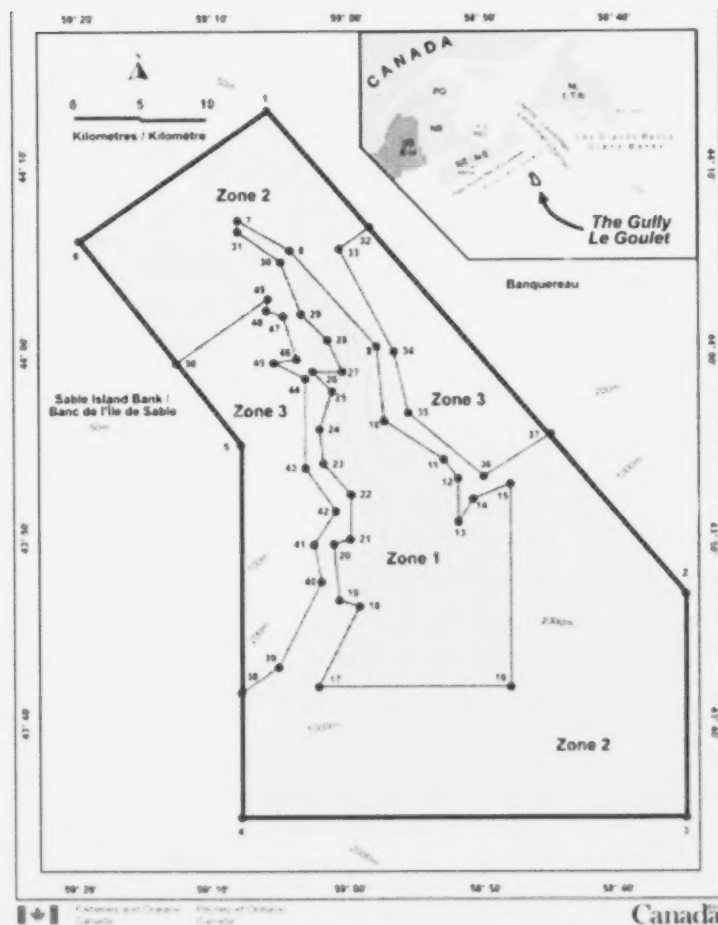


Figure 14. The Gully Marine Protected Area.

Objective

Protect the diversity of coral species in the Gully.

Legislation/Regulations

The Gully was designated an MPA under the *Gully Marine Protected Area Regulations (Oceans Act)*.

Fisheries Act (Atlantic Fishery Regulations): Licence conditions for fisheries in 4VSW have been amended to reflect the Gully MPA Regulations

Size and restrictions

The Gully Marine Protected Area is 2364 square kilometres in size. Zones 1 and 2 of the MPA, where most corals are found, are approximately 1900 square kilometres. In general, activities that disturb, damage, destroy or remove marine organisms or any part of their habitat are not permitted in The Gully. However, there are special exceptions for halibut, swordfish, tuna and shark fishing in zones 2 and 3 of the MPA. Other activities may be permitted in Zone 3 on special application and provided they meet certain conditions.

Petroleum activity within the Gully is currently restricted under the Canada-Nova Scotia Offshore Petroleum Board's Sable Gully Policy.

